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*PROBLEMS AND POSSIBILITIES OF SYSTEMATIC BOTANY.**

THESE annual summer meetings of our Society, occurring as they do between the close of one year's academic activity and the beginning of the next, offer an excellent opportunity not merely for profitable retrospects, but for such interchange of ideas as may stimulate renewed effort. The summary of results achieved, although a natural and desirable part in the proceedings of an assembly of this sort, is subject to a growing difficulty from the ever-increasing technicality of modern research. We live in an age of great detail and at a time when our subject has branched into many narrowing paths of investigation. Thus, even at a meeting of highly trained botanists, there is less common ground than we could wish, and it is scarcely possible, without the certain ennui of most of our colleagues, to present the finer results in those particular researches which may have stirred us individually to great enthusiasm. On the other hand, the aims and methods in our varying lines are by no means so unlike, and afford an ever-fertile field for discussion and comparison. It may be further maintained, in defiance of any suspicion of prejudice, that the aims and methods of systematic botany should command an especial and very gen-

* Delivered at Denver, August 28, as an address by the retiring President of the Botanical Society of America.

eral interest. No department of our subject is more intimately associated with every other. No other branch of botany so completely underlies all phases of botanical work. For what botanical investigation does not depend for its value upon a correct identification of the plants with which it deals? An accurate, lucid and complete classification of plants is thus the only secure basis upon which botany as a whole can rest. What is the present strength of this all-important foundation? Is it built upon rational principles? Should we build on or tear down and reconstruct? Is it nearing completion or does it represent as yet only the earliest stages of the desired structure? These are questions scarcely less significant to the physiologist, ecologist, pathologist, horticulturist or pharmacist than to the systematic botanist.

In surveying the taxonomic work of the last decade we see on every hand evidences of great and increasing activity. Small genera have become large; easy groups have become intricate. Thin periodicals have grown marvelously fat—in pages, not, alas! in pecuniary receipts. The number of regular and irregular publications has vastly increased. Species have been made by the thousand. No previous period of similar length has turned out such a bulk of systematic literature. It is true that this copious and now decentralized publication is of all degrees of merit, yet no one would wish to deny to it a reasonably high average of excellence. I speak, of course, of those papers which aim at the record of serious research. From these considerations and in the presence of this extraordinary activity there can be no doubt that systematists are making flattering progress in at least one direction; they are, namely, recording a huge number of facts.

Facts, however, can be accumulated much faster than they can be sorted and arranged. They are, to carry out our figure, only the bricks for the structure, and to be effective building material must be laid in a firm mortar of law, organization and proper association. The chief difficulty which now besets our subject is the overwhelming accumulation of uncorrelated facts, unmonographed species, disjointed observations, preliminary and fragmentary records. The summit of our structure, instead of presenting a fairly clear and firm surface for further construction, seems to be buried at many points mountain-deep by disorderly heaps of loose bricks, in their way excellent building material, but so carelessly piled together as to impede rather than assist those who are earnestly endeavoring to bring order into this threatened chaos. Let no one understand me as discouraging the accumulation of facts—even very small facts—relating to the classification of plants. We do not know half enough even about the commoner species. I would merely urge that those who publish should take far greater pains to present their facts in an orderly and lucid way, with reasonable terseness and in such a manner as to show clearly their relation to preceding observations in the same field. This is the first possibility for advance in systematic botany and, if I mistake not, many other branches of research are in like case.

In this matter of presentation the natural sciences seem to be at a peculiar disadvantage. In belles-lettres a work of crude literary form is damned. Authors, if they would be read, must cultivate a good style. But in the natural sciences, if a work only presents some new and valuable facts it must, in spite of the crudest form, be purchased, read, reviewed, quoted, and the author is often flattered by the seeming success of a paper which may have been little better than an imposition upon his colleagues. Some improvement may undoubtedly be accomplished if the scientific public, especially editors and reviewers, can be

stirred to a more critical attitude toward work defective in form. But important advance can only emanate from the authors themselves. They should take a greater pride in the style of their publications, should realize that lucidity of exposition goes far to carry conviction, while obscurity is positive injustice to their coworkers.

Let us take, for instance, the publication of a new species. The requisites of a good description are generally known. There should be the habital picture, giving in a few words an idea of the general form, size and nature of the plant as a whole; then a considerable number of features should be tersely described; special care should be taken to point out the differential characteristics by which the plant is distinguished from its nearest relatives; and finally full information should be given with regard to the occurrence of the species, its type, locality, collector, date and exsiccati-number of the type-specimen, with a mention of the herbarium in which it is to be found. These are usually simple matters, and their business-like statement in relation to every new species is a generally-recognized obligation of its author to his colleagues, yet it is safe to say that not one-half of the species published during the last year have received descriptions which fulfilled these simple conditions.

On the one hand insufficient characterizations still occur. A well-known botanist has recently described a new leafy-stemmed phanerogam, without mentioning root, stem, branches, leaves, pubescence, calyx or fruit. However, this sort of insufficient description is becoming rare. The need of fullness is widely recognized, and great improvement in this regard has been manifested in recent years. *Enough* is generally said. Quantity in the description is no longer such a desideratum as proper arrangement, judicious selection, and especially some form of emphasis by which the really important, invariable, and therefore diagnostic, features may stand out in high relief. As I have said, the author of a new species owes clarity to his colleagues. This obligation is not fulfilled by a page and a half of description in which, without particular emphasis, all manner of characteristics are given, ranging from those which concern a group or even family down to others so detailed as to apply only to the single specimen in hand. Here is another possibility for advance, namely, the discrimination and proper emphasis of differential characteristics in description.

Here authors can bring to bear all the keenness of insight which they possess. To estimate correctly the value of plant differences is by no means easy. To a great extent their permanence and consequent taxonomic significance can only be a matter of inference based upon a knowledge of similar differences in other groups. This fact seems to have discouraged some of our systematists to such an extent that they wish to escape all responsibility in relation to the matter. They give what is called a good full description without the slightest effort to show the relative importance of the points they mention. They trust that a future monographer will somehow extract from their miscellaneous statements or find upon their so-called types certain significant differences which will serve to distinguish their plants from all others.

It may be doubted, however, whether a writer is justified in publishing a species until he sees with clearness its differential characteristics, and certainly when he sees them he has no right to hide them without any mark of distinction in a mass of other details of little or no taxonomic significance. Let us hope that, in this regard, the coming decade may see the same improvement which the last has witnessed in the increased fullness of descriptions, and that a systematist's work may be estimated, not by the

number of plants he publishes nor by the pages of descriptions he writes, but by the clearness with which he ascribes true differential characters and the actuality of his species in nature.

Regarding the citation of the type, there is in some quarters still a carelessness or indifference which is little short of astonishing. Species are still, in some cases, and even by persons prominent in systematic botany, published with no more definite information as to habitat, collector or type than the bald statement that the plant appears to be common from Vermont to Michigan and southward to Virginia.

I have heard certain attempts to justify this sort of thing. It is said, for instance, that the citation of a type-number is likely to mislead; that even the best collectors occasionally distribute unlike plants under the same number; that Pringle's 1507 at the Philadelphia Academy of Natural Sciences may not be just the 1507 at the Arnold Arboretum; that a species is more than an individual, and if a single type is cited there will be danger that some will narrow the interpretation of the species until it is artificially confined by those individual characteristics which the type-specimen chances to exhibit. But these are weak excuses. The probability is that Pringle's 1507 will be the same species wherever found, and if by any chance this is not the case a well-drawn description will go far to remove the danger of error. It is, furthermore, always possible, indeed desirable, to state the particular herbarium in which the type is preserved and thus remove all ambiguity. The other objection to the citation of type-specimens has quite as little force, for persons given to such fine-haired discriminations that they separate so-called species on individual traits are bound to interpret a described species in the light of some supposed representative of it, and in the interests of accuracy it is much better that this individual should be the type rather than some specimen which from its characters or presence in the author's herbarium is merely assumed to represent the species in question. It would seem, then, that an author who does not cite his types is careless or unduly timid, and it is to be hoped that negligence in this matter, of which drastic examples might be given, may be regarded with increasing disfavor. Happily, here, as in the other matters mentioned, there are hopeful signs of improvement, and some of our most important botanical establishments, for instance the United States Department of Agriculture under its present direction, have been exemplary in this regard.

On many accounts it is to be regretted that the commendable custom of describing new species in Latin has been so generally abandoned in America. Still common in England, it is almost universal in continental Europe, and as a means of uniformity it is a source of much convenience. The Latin language by its high inflection and wealth of terse adjectival expressions lends itself exceptionally to the clear and compact presentation of details, and the formal description in Latin undoubtedly requires added attention to subject matter as well as form, while the running characterization, so easily dashed off in the vernacular, is to some extent a temptation to verbosity and hasty publication. The habit of writing descriptions in Latin would also exercise a chastening influence upon nomenclature. An author who could produce an intelligible Latin characterization would scarcely name his plant *pseudolongifolia* or *pulchrissima* or *nationalparkensis*, and these are scarcely overdrawn illustrations of the crudities into which some fall who have utterly abandoned Latin in the presentation of systematic botany. In regard to this matter of names, it may not be remarkable that there are some beginners whose enthu-

siasm in publication far outstrips their general scholarship; but one may express genuine surprise that the heads of important botanical departments and editors of prominent journals let these nomenclatorial solecisms see light in print. Here is another opportunity for easy improvement in the methods of systematic botany.

To this point I have dealt chiefly with the form of presentation. Let us now consider the subject matter. Here the difficulties of improvement are naturally greater.

The first feature of this subject which demands attention is the artificiality which still lingers in our so-called natural system. It is true that the natural arrangement of orders and families has been much improved in recent years. The clues derived from the varying degrees of adnation, connation and zygomorphy of floral parts in the dicotyledons have suggested the first system in which groups of such obvious affinity as the *Caryophyllaceae*, *Aizoaceae*, *Scleranthaceae* and *Amaranthaceae* are found in natural proximity. But much artificiality still remains in the details of modern classification. For instance, we are commonly treating as equivalents in our system things which in nature have widely different values.

There is an old question always coming up, ever fresh for discussion, never very clearly settled, regarding the objectivity of species. Do they exist in nature or are they artificial categories? Much may be said on both sides. It takes, however, no very profound study of plants and their descriptions to reveal the fact that so-called species are of both kinds. Many thousands exist as well-marked entities in nature, but, alas! there are many hundreds more which scarcely extend beyond the subjective. They represent not permanent lines of more or less independent development in nature, but chance combinations of inconstant characters analogous to cross-sections through some plastic and still unsolidified material.

The cause of this lies partly in the author of the species and is partly inherent in nature. On the one hand, such so-called species may result from the hasty description of plants whose differences, observed in a few herbarium specimens, have not been sufficiently verified in the field. On the other hand, they may come from the simple fact that there are no formed or settled species in the group concerned. The forms of that particular affinity are still in a state of free intergradation and the species *im Werden begriffen*.

There seems to be a wish upon the part of many systematists to ignore this fact; to maintain that this or that form is, in hackneyed phrase, a 'perfectly good species' because it shows certain differences from its slightly removed although copiously intergrading neighbors; in fact, to asseverate that all plants which show differences worthy of remark should, irrespective of their constancy, be classed as species. But notwithstanding these unhappy ideas, nothing can be more certain than that fortuitous cross-sections in the nebulous places of nature are not species in the sense that *Ranunculus pennsylvanicus*, *Juncus trifidus*, *Malva rotundifolia* or *Potentilla tridentata* are. Nor can we hope to escape great artificiality in any system which assigns to like rank and groups in the same category things of such diverse nature and significance.

Species as now recognized are not equivalent things. The category, called specific, is itself a complex, in the same need of critical study, of subdivision, of segregation, as many of its elements. There are species marked by pronounced morphological features, which they never lose and which may always serve to identify them. There are others with characters subject to concomitant variations, in which if one feature varies in a particular direction the change

is regularly accompanied by certain other modifications affecting other members. Such species may be subdivided, and have good subspecies or varieties. On the other hand, there is a totally different type of species in which variation is not concomitant, in which one feature changes without apparent connection with any other, in which, for instance, thorns may be developed or be absent, while leaflets may be few or many irrespective of the presence or absence of thorns, and again, the inflorescence may show further variation quite independent of leaflets and thorns. Such species, exhibiting what Dr. Gray called promiscuous variation, are well illustrated by *Acacia filicina*, *Mimosa asperata*, certain Aquilegias, Delphiniums and Lupines. In these cases segregation or even varietal subdivision, although often attempted, has little or no significance, for the segregates exhibit only kaleidoscopic combinations of ever-changing characters. There are, on the other hand, especially as the result of preponderating close fertilization or vegetative reproduction, species which exhibit a wonderful constancy of small characters, a remarkable fidelity in transmitting from one generation to the next the most obscure traits. Such are the segregates of *Draba verna*, elaborated by Jordan, studied with such keen interest by de Bary during the last months of his life and critically reviewed in the later work of Rosen. Such are also the newly recognized Alchemillas of the Alps and our own Antennarias.

From these illustrations it is easy to see that species as now recorded in literature are by no means alike and that they cannot be regarded as equivalents in any complete or logical system of classification. Curiously enough, however, the term 'species' seems to be growing more and more popular as it means less and less. Often and on all sides we hear lengthy arguments, and emphatic asseverations to the effect that this or that plant is a 'perfectly good species'; and if in the course of monographic work a so-called species is let down to varietal rank it rarely fails to find somewhere its ardent defenders, who appear to hold the curious view that the monographer has not merely expressed a scientific opinion, but has somehow perpetrated an injustice upon the plant or its describer. How anxious most discoverers of new forms are that their plants may prove species, not mere varieties, and finally what a fascination the mere binomial appears to exert upon certain minds! Is it any wonder under these circumstances that the specific category has been overcrowded and made to include such widely different elements that the word species has lost nearly all its taxonomic significance?

However, no thoughtful botanist who can rise above a merely subjective attitude toward the few species in which he chances to be particularly interested and take a broader, more objective survey of the whole field, will be satisfied that the present hodgepodge of non-equivalent forms in the specific category represents the finished result of a natural system of classification.

Species must be subjected to a gradual reclassification along more definite lines. Overwhelming as the task may at first appear, it is fortunately one which can be taken up little by little, a work in which every systematist, every collector, every amateur, who will, may take part. The first step is evident enough. Each species must be examined in the light of vastly more copious material than at present exists even in our largest herbaria. Has there ever been a conscientious monographer who has not seen the pressing need of further material in his group, who has not felt that ten or even a hundred times as many specimens would have been necessary to yield a satisfactory knowledge of the directions and limits of variation? Let

us, then, proceed with the accumulation of material, with the collection of specimens which may illustrate each species at every stage of development, in every part of its range, in every environment in which it occurs. In this matter we are much behind zoologists. They often work with hundreds or even thousands of specimens while we try to draw like inferences from dozens. An entomologist recently told me, quite as a matter of course, that he had just completed a monographic examination of more than fifteen hundred specimens representing a single species of orthopterous insect, together with three or four of its varieties. When may we expect that botanists will take similar pains in the interpretation of the limits and variations of a single species?

While on this subject of collection I may be permitted to emphasize an often neglected obligation of the collector to the monographer—that of reasonably full field notes. I realize that this is a wearisome subject, well known and thoroughly appreciated by many conscientious botanists and as persistently disregarded by others. I am acquainted, for instance, with several expert systematists, most scrupulous in all other ways, who appear on this subject of labels to have a curious mental defect. They never seem to have grasped the art of writing them, nor realized in this matter any obligation whatever toward their colleagues. From one of them I recently received some excellent specimens with no data but 'White Mountains.' Repeatedly, when working upon a particular species at the Gray Herbarium, I have examined dozens of specimens from many different collectors in the vain hope of learning from the field notes upon the labels such simple facts as the color of the corolla, height of the plant, or nature of the soil where it grows. Here is another opportunity for advance in which nearly every one connected with systematic botany can coöperate.

We have seen, then, that the first requisite for a more thorough proving of species is a much greater and more representative accumulation of material and data. Then, of course, will come the difficult task of interpreting this material and especially of determining for general guidance more definite standards of variation. Regarding this latter possibility I have heard some scepticism expressed; but it seems to offer no greater difficulty than many other problems which have been successfully settled in the natural sciences. It must be admitted, of course, that while our knowledge of particular species is derived from a dozen, or in some instances from only one or two, specimens, no satisfactory standards of variation can be devised or applied. But were we to work with a hundred times this amount of material, it is more than probable that the degrees of natural intergradation could be fairly approximated. It would at least become evident which lines of specific development had attained what may be called a normal distinctness, a condition in which intergrades would be so exceptional as to suggest atavistic reversions, while, on the other hand, many of our so-called species would doubtless be found to be connected by regular, normal and fairly numerous natural intergrades, their lines of development would still be in a state of anastomosis, not having attained habitual distinctness. The interesting question would then arise whether the intergradation were geographically general or local, whether it were morphologically concomitant or promiscuous.

To interpret these matters satisfactorily will require not only the vast accumulation of material the need of which has just been emphasized, but a cautious and judicial attitude of mind, great impartiality, and an

unswerving desire to find out and record the exact truth. I do not mean to imply that systematists to-day have not this desire. Unfortunately, however, many of them, perhaps all, seem never to escape a certain hypnotism caused by particular interests. Trifling matters assume undue importance. Little differences seem so great as to obscure the preponderating similarities, or, on the other hand, superficial likeness blinds the observer to every differing detail. An opinion is quickly formed and perhaps hastily published. It then becomes a matter of personal pride to maintain it, and if any one expresses a doubt concerning its accuracy he is promptly called out to a controversial duel.

Now these things have their bright side and are in their milder form diverting, for somehow after the scrimmage which follows, truth, for the time hidden by the dust of combat, usually shines forth in victory, or more often becomes evident as the result of compromise. Indeed controversy is perhaps the only means which will successfully dispel the narrowing and perverting influence proceeding from the intensive examination of small details, and so often blinding the systematist to the real perspective of his own observations.

If we now turn from the matter of variation to that of distribution, it is equally evident that only a beginning has been made, that inferences are drawn from very insufficient material and that a vast accumulation of further data is requisite to accurate results. Let any one who doubts try to bound the range of some common species, to draw upon a map the sinuous line connecting the outermost recorded stations. The gaps are astonishing. Great lacunæ quickly appear in our knowledge of plant distribution.

No one can doubt the value of much fuller records in this department of our subject, nor maintain that our knowledge of any plant is satisfactory until the limits of its natural occurrence are accurately determined. While plant distribution, studied from the ecological side, has become a popular subject, comprising many useful observations and theories both valuable and fascinating, the actual record of plant-ranges is on the whole regarded as rather dry business and is a field of investigation in which laborers are few. Mention should be made, however, of Professor A. S. Hitchcock's admirable work in this direction upon the flora of Kansas. What notable advance might be made if each State of our Union could have an equally well-trained systematist similarly interested in this matter of plant distribution!

Could we but know the actual curving boundaries of a few hundreds of our best-defined species, what a wealth of new generalizations could be drawn from them, and how much new information they would yield concerning the factors which govern distribution in general! For, irregular as these lines would be, I can but think that they would in many cases stand in definite relation to lines of other kinds, to isothermals, to altitudinal contours, to degrees of humidity, to the boundaries of geological formations, the limits of glaciation, the ranges of animals, especially pollen-bearing insects, to the paths of bird-migration, and finally, to the course of human traffic. What a field for further investigation is thus suggested by our still very imperfect knowledge of plant boundaries! It is a field, too, which the careful amateur can cultivate almost as easily and as well as the professional botanist. Every one lives near the assumed limits of some plants and might, by directing his attention to the subject, do much to change these as yet vague and hypothetical boundaries into accurately determined and carefully recorded lines.

Not only would these lines be likely to

disclose new and as yet unsuspected relations to forces controlling distribution in general, but they would give us our first accurate landmarks for the observation of plant migration, thus greatly facilitating a study of progressive changes in our flora.

While the accurate determination of plant boundaries has thus great interest it may be remarked that research in this field, as in others, to be successful, must be conducted with care. Reports of occurrence, especially extra-limital stations, should be taken with much caution. In this as in many other matters of science it is impossible to make too sharp a distinction between facts actually observed and those taken on hearsay. In mapping a plant the recorder will do well to indicate this difference. If, for instance, he shows by an umbra the range which rests upon specimens personally examined, let him record unverified reports only by a penumbra. Furthermore, any work of this kind to be of permanent value must rest, at least in great part, upon specimens which are carefully preserved, for segregation is progressing rapidly and no one can foresee its subjects. A plant of supposedly uniform character may at any time prove, upon more critical observation, to be two or more distinguishable species. In such a case it is easy to see that any previous study or records of the composite plant must lose nearly all their value unless specimens have been preserved so that a re-examination will show to which of the segregates the records applied. Similarly, the disappearance of a plant from a given region may lead to a justifiable scepticism as to the accuracy of the records relating to its occurrence in that place. In this case, practically the only valid proof is a preserved specimen accompanied by the original data of collection.

In interpreting and recording this matter of plant boundaries opinions will doubtless differ as to what may be called continuous range and what is to be regarded as an extra-limital station, or, so to speak, an island in a sea of non-occurrence. This is, of course, all a matter of degree, since in reality no plant has a continuous range, for it is represented by more or less isolated individuals. Yet this offers no serious obstacle. The meteorologist maps the analogous course and limits of a rain-storm composed of separate drops, and the biologist has long recognized the practical continuity of plant and animal ranges which, in a generalized form, are the basis of his so-called 'life-zones.'

Turning now to quite a different field which seems to offer great possibilities, I would call attention to recent researches in plant ontogeny: the investigation of embryonic development, the comparative study of seedlings, and such observations as have been recently made by Professor R. T. Jackson upon the reappearance of juvenile and ancestral traits in offsets and runners. Systematic zoologists have long made use of ontogeny in determining group affinities, but botanical taxonomists have been much less successful in drawing from the early stages of plants like inferences. There are several reasons for this. In the first place, there can be no doubt that plants in their early development do not exhibit such a continuous and complete series of philogenetic stages as many animals do. In plants some stages seem to have dropped out by a sort of morphological and physiological elision or ellipsis. Again, while the classification of animals rests upon general morphology often well suggested even in very early stages of development, the classification of plants is based chiefly upon the mode of reproduction—that is to say, upon a series of structures produced so late in the life of the individual that no suggestion of their character is afforded by embryo or seedling.

But, after all, there can be no doubt that

ontogeny has for the plant taxonomist a wealth of information as yet unrevealed regarding the affinities of genera within the family and species within the genus. In these matters of more intimate relationship, the form, position and venation of leaves, the nature of the petioles, stipules, pubescence and glandularity, all shown in the seedling, are significant.

Here, however, as in the other subjects of which I have spoken, the real obstacle to further inference at present is an astonishing lack of material and data. It is safe to say that of the one hundred and fifty thousand flowering plants recorded in the recently issued Index Kewensis not one fiftieth part has been carefully traced through the earlier stages of development. Enough is known, however, to show that species even of the same genus often possess striking differences, and in other cases remarkable similarities, in the seedling stages, that these particular differences and similarities often become lost or obscured as the plants advance to maturity, and the conclusion is unavoidable that these juvenile characteristics must, at least in many cases, show ancestral traits, and, if properly studied, yield even better clues to real affinities than any which we now possess.

By way of summary, it may be said that systematic botany is very far from being a completed subject, that from our present standpoint we can see in various directions long vistas of further possibilities for fascinating exploration and profitable discovery, that among the subjects which seem to invite immediate attention the most important are: (1) The determination of the modes and degrees of variation, an investigation which alone can yield data for a more critical discrimination of plant categories; (2) far more complete study of plant ranges, which can scarcely fail to throw much new light upon the forces controlling distribution; and (3) a further examination of plant ontogeny as the most hopeful source of information regarding the more intimate affinities and proper arrangement of plants.

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THE CHANGE OF FRONT IN EDUCATION.*

Dr. Samuel Johnson considered education as needful to the 'embellishments of life.' In his day very few were educated at all, and those few for society or public service. The toiling masses had no education, were supposed to need no education, and while discussing details educators and scholars took no thought of what we call the common people.

Said Johnson (in his 'Life of Milton'): "The truth is, that a knowledge of external nature, and the sciences which that knowledge requires or includes, are not the great or the frequent business of the human mind. Whether we provide for action or conversation, whether we wish to be useful or pleasing, the first requisite is the religious and moral knowledge of right and wrong; the next is an acquaintance with the history of mankind, and with those examples which may be said to embody truth, and prove by events the reasonableness of opinions. Prudence and justice are virtues and excellences of all times and of all places. We are perpetually moralists, but we are geometricians only by chance. Our intercourse with intellectual nature is necessary; our speculations upon matter are voluntary and at leisure. Physiological learning [by which he means a knowledge of the laws and phenomena of the external world] is of such rare emergency, that one may know another half his life without being able to estimate his skill in hydrostatics or astronomy; but his moral and prudential character immediately appears.

* Address of the Vice-President and Chairman of Section I, Social Science and Statistics, of the American Association for the Advancement of Science, Denver meeting, August, 1901.

"Those authors, therefore, are to be read at schools that supply most axioms of prudence, most principles of moral truth, and most materials for conversation; and those purposes are best served by poets, orators and historians."

This statement was, no doubt, entirely adequate to the demands of Johnson's time. Polite conversation and elegant manners were the chief characteristics of an age in which Chesterfield was a bright and shining light. With the dull, hard-working, unlettered crowds, that plodded on in the steps of their grandfathers, educators had nothing to do; for such they had no educational theories.

How wonderfully conditions have changed, both as to the curriculum and as to the constituency of education. It is interesting to picture, in fancy, the bewilderment of a Sam Johnson in the learned circles of this scientific and industrial age. Imagine him attempting to join in the discussions of our British and American Associations for the Advancement of Science, in our educational conferences, or in the halls of exchange, where the active minds of our generation do mostly congregate. He would find it difficult, in spite of the wonderful vigor of his intellect, to be either useful or ornamental, though he could easily be amusing.

From the days of John Milton, in 1608, to the end of the eighteenth century, university training culminated in a preparation for the professions of law, medicine and theology, and in the training of the nobility for the duties and responsibilities of government and elegant society.

But when alchemy developed into chemistry; when physics became an experimental science; when Leibnitz and Newton elaborated the infinitesimal calculus; when Watts invented an efficient steam engine; when Fulton built a successful steamboat; when Stephenson devised the locomotive and constructed a road with smooth rails; and finally when Siemens and Gramme produced the electric motor—vast fields of fascinating and useful material were opened for study and research. Mathematical analysis and the principle of mechanics, which had previously been devoted to the problems of physical astronomy, were now directed to the study of the transformation and transmission of energy, the theory of structures, and the phenomena of electricity. The theory of evolution gave a new meaning to all vital phenomena; and the doctrine of the conservation of energy permeated all study of motion and force.

In the earlier days, Alexander Pope voiced the popular notion that 'the proper study of mankind is man.' 'Nature Study,' which to-day is the bright, attractive feature of the primary school, and equally the inspiring field of the savant, was not countenanced by polite society. For centuries it was held to be little short of blasphemy to wound the earth by digging for ores which were intended to be hidden away from our sight and touch, or to attempt in any way to improve upon God's workmanship. When in 1680 a Spanish engineer proposed to deepen the channels of certain rivers and to restrain their overflows in the interest of navigation, the Spanish Council decreed as follows: "If it had pleased God that those rivers should have been navigable, He would not have needed human assistance to make them so; but as He has not done it, it is plain that He does not want it done"; and the improvements were forbidden. This decree reminds me of a bit of Mrs. Eddy's logic which you may remember in substance as follows: Had the Almighty intended that drugs should be used in treating sick people, He would have placed drugs in the hands of Jesus and his disciples; Jesus and his disciples used no drugs; it is therefore evident that the Almighty does not wish drugs to be used upon people who are sick.

But, putting aside pseudo science, the modern thought of the creation is that it was and is a part of the all-wise plan to fill the earth with unsolved problems, the study and solution of which should develop our best powers, and at the same time cultivate our highest instincts of reverence for the Creator and of love and devotion for His creatures.

It has taken many centuries for the world to discover that the great forces of nature are neither sacred nor profane, neither kind nor cruel, that they neither love nor hate, and that they are more unchangeable than the stars; that shrines and temples, priests and priestesses, tripods and oracles, have been in vain, except so far as they reacted upon the human heart and satisfied its natural craving for the worship of the Superior Being. Instead of building a temple to the far-darting Apollo or to Zeus, the Thunderer, we now stretch over our cities a network for artificial lighting; and all the winds that blow and all the waters that flow are made to furnish their tribute to our comfort and pleasure. We tap the sources of endless energy and transmit it through all the ramifications of our social order, relieving mankind from heavy burdens and creating hundreds of occupations hitherto unknown.

Out of this vast extension of the horizon of human activities, and a corresponding multiplication of occupations, has come an imperative demand for more education and for technically educated men. In our industrial system the crying want has been and is for men who can both plan and execute. The secret of our unparalleled commercial and industrial success lies in the fact that we have put educated brains into our work. Hence a score of professions unthought of 100 years ago have been called into being, and the standards of these new professions are of the highest order.

It is this grand movement towards a study of the materials and the forces of nature and the problems of modern life, sociological, commerical and industrial, that constitutes the change of front in education. This does not mean that we must abandon altogether the old education. We must preserve all that is permanently fine and essential to high thinking and well doing. The great epics of Homer, like the book of Job and the Psalms of David, will live forever, imperishable monuments of the youth of the world, but we shall not perpetually care for Aristotle's speculations about the origin of matter, or the conceited discussions of Cicero at Tusculum. Modern life in all its details has so far departed from the ancient that neither the moralizings nor the tragedies have a lively and sustained interest for us. We are deeply interested in the affairs of to-day, in a civilization not based upon human slavery, nor upon a blooded aristocracy buttressed and supported by millions of laborers ground down in ignorance, poverty and superstition, but based upon the principle of human equality before the law, and of equal rights to life, liberty and the pursuit of happiness.

In turning from an inherited scheme of education which faced backward, which concerned itself largely with the thought, the deeds and the theories of the past, and in proclaiming the universal need, as well as the universal opportunity, of education, we must not fail to preserve the dignity and the nobility of our educational standards. In spite of frequent assumptions to the contrary, modern education is becoming more and more 'liberal.' The defenders of the Johnsonian programs delight in the use of unworthy epithets with which to characterize the tendency of modern education; they plead for 'humanities' as though anything human was foreign to our curriculum. What can be more human than human life as we see it

and as we share in it? What problems can be more human than those which face nine out of ten of the people who reach the age of individual responsibility?

More and more we are considering the many and not the few, when we draw up our schemes of study and training. As wealth increases, as the hours of labor become shorter, as luxuries multiply, and a taste for literature and art and science becomes general, the number of students entering upon some form of higher education greatly increases. The number of such students to-day per million of people has doubled several times in fifty years.

It is, therefore, not surprising that there should arise, in the minds of many less familiar with the content and the method of a modern technical university, a fear that the standards of character as well as the standards of scholarship should suffer, and, in being less 'select,' that the content of education should be at the same time less fine. Whether this fear be well grounded or not, we must all sympathize with its spirit. We can have no quarrel with those who wish the first fruit of education to be character. I cannot forbear quoting a few sentences from the late president of the Massachusetts Institute of Technology, Gen. Francis A. Walker, upon the tendencies of modern technical education, in reply to certain strictures as to its dignity and unselfishness. In his remarks at the dedication of new science and engineering buildings at McGill University, Montreal, General Walker said:

"The notion that scientific work was something essentially less fine and high and noble than the pursuit of rhetoric and philosophy, Latin and Greek, was deeply seated in the minds of the leading educators of America a generation ago. And it has not even yet wholly yielded to the demonstration offered by the admirable effects of the new education in training up young men to be as modest and earnest, as sincere, manly and pure, as broad and appreciative, as were the best products of the classical culture, and, withal, more exact and resolute and strong. We can hardly hope to see that inveterate prepossession altogether disappear from the minds of those who have entertained it. Probably these good men will have to be buried with more or less of their prejudices still wrapped about them, but from the new generation scientific and technical studies will encounter no such obstruction, will suffer no such disparagement.

"Another objection which the new education has encountered is entitled to far more of consideration. This has arisen from the sincere conviction of many distinguished and earnest educators that the pursuit of science, especially where its technical applications are brought strongly out, loses much of that disinterestedness which they claim, and rightly claim, is of the very essence of education. I differ from these honorable gentlemen. I believe that the contemplated uses of science, whether in advancing the condition of mankind, or even in promoting the ulterior usefulness, success and pecuniary profit of the student of a technical profession, do not necessarily impair that disinterestedness. These gentlemen appear to me to have an altogether unnecessary fear of the usefulness of science.

"The strong desire to become a useful man, well equipped for life, capable of doing good work, respected and entitled to respect, constitutes no breach of disinterestedness in any sense of that word."

Finally he says:

"I boldly challenge comparison between the scientific men of America, as a body, and its literary men or even its artists, in the respect of its devotion to truth, of simple confidence in the right, of delight in good work for good work's sake, of indis-

position to coin name and fame into money, of unwillingness to use one thing that is well done as a means of passing off upon the public three or four things that are ill done. I know the scientific men of America well, and I entertain a profound conviction that as regards sincerity, simplicity, fidelity and generosity of character, in nobility of aims and earnestness of effort, in everything which should be involved in the conception of disinterestedness, they are surpassed, if indeed they are approached, by no other body of men."

Of like import are these words from a recent address of Hon. F. W. Lehmann, of St. Louis. Speaking of the breadth of the modern university, he said:

"The university of to-day has abdicated none of its old functions, but it has taken on many new. Not disdaining mere scholarship, making, indeed, the standard always a higher one, it widens its domain and adapts its teachings to the after-work of life. Its graduates are not simply conventional finished gentlemen, but beginners in the serious business of life, scholars as before, but artists, engineers and artisans as well. The sciences lose nothing because they become utilities. Physics and mathematics gain in interest by application to the building of bridges, and the very sewers of a city become classic to the scholar because one of the means to the classic excellence of a sound mind in a sound body."

Perhaps the characteristic most dreaded by the opponents of the new education is usefulness. They have but to learn that a certain branch of study, course of training or line of culture is useful, and its value is at once compromised. One of the few foolish things that Lowell ever wrote or said was that, 'a university is a place where nothing useful is taught.' I will not discuss a statement which, after all, may not do justice to Lowell's thought, but I will define a university as a place where everything useful in a high and broad sense may be taught. Matthew Arnold would have defined a university as a place where is taught and illustrated 'the best that has been thought and done in the world.'

Supt. Gilbert, of Rochester, N. Y., said at Buffalo last month: "The exalted character of a man's work is to be measured by its usefulness to mankind; I believe in the universality of service."

It has often been assumed that this new education is not liberal. Liberality consists not so much in the subject as in the method of study. The liberal method is broad, deep, generous, comprehensive. It recognizes infinite uses, both far and near. It aims at the artist rather than the artisan; the engineer, not the craftsman; the freeman, not the slave. Liberal culture deals with fundamental principles, typical phenomena, general results, not special applications. It is liberal to study the laws of manufacture, trades, commerce, finance and social progress; it is not liberal to seek merely the conditions of a successful business, whether it be law, medicine or manufacture. It is liberal to demand the *raison d'être* of dogma, canon, rule, dictum, formula or usage; it is illiberal to blindly follow authority, to put facts and processes above principles and reasons, to prefer echoes to living voices.

A recent reviewer said that mathematics and electricity are becoming less valuable for general education on account of their increasing usefulness in technical pursuits. The maximum of educational value (he held) appertains to a sort of knowledge which falls short of such a mastery as makes it useful. Of course, I accept no such statements. That man's notion of a liberal education is not yours nor mine.

The list of liberal branches of study is ever increasing. For four years Harvard compelled me to give one-sixth of my time to Greek and one-fourth to Latin; to-day

one may go through Harvard and take his degree without giving one moment to either Greek or Latin, while in Cambridge. The same thing is true at many universities. Are we, therefore, less liberal than formerly? Can we not answer that we are more liberal? People now read Demosthenes and Quintilian and Horace, analytic geometry, physics, thermodynamics and the like, because they wish to be familiar with those authors or to master those subjects, not because they are compelled to by a traditional canon. Does any one suppose that there is not a decided gain in the quality of the result?

Through the technical schools, some of the most valuable educational studies have been developed. How few people realize the surpassing mental discipline that comes from the study of descriptive geometry, laboratory physics and the mechanic arts. I knew nothing of the study of descriptive geometry till years after I left college, and yet no subject I had in college could compare with it as a mental stimulus and a cultivator of the scientific imagination. It ought to have place in every liberal course of study. Modern courses of study contain, of necessity, extensive allowances of laboratory work of one sort and another. Our idea of all such work is that the method shall be unfailingly rational; that facts, though essential, shall be rated as far less important than the principles which underlie them. Where this idea is realized, the study becomes truly liberal.

In spite of the old claim of preeminent liberality, the old college curriculum, when examined historically, is found to have been adopted for reasons of utility. People learned Latin because they wanted to use Latin. All books and state papers were written in Latin, and one needed to both read it and write it, as we must English prose. The physician must read Galen in the original; the clergyman needed the Greek Testament; the lawyers must read the Institutes of Justinian, and the man of leisure and the orator must be able to quote Aristotle and Homer, Virgil and Horace. The first American colleges were organized for the training of clergymen. Every feature of the course was directly useful to the end in view.

It is easy to see the source of a widespread prejudice against technical training. The history of civilization has been the history of masters and slaves, of castes, of contempt for labor and for all useful arts. Every one of the technical professions had its beginning in the crafts and the present technical expert and engineer had as a prototype a man in overalls, with horny hands and a soiled face, who presided over some enginery which was not authorized by the ancients and which at best was generally regarded as ungenteel. Milton placed Memnon, the first ante-tellurian engineer, among the fallen angels, and sent him

'With his industrious crew to build in hell.'

The engineer is by nature an iconoclast. He has small respect for the traditions. He bows not down to the 'tyranny of the ancients.' His glories are in the future. He looks forward, not back. He does not hesitate to smile at the puerile fancies of people who created gods and demi-gods in order to account for phenomena which to-day submit to mathematical analysis and which bear no comparison with the exploits of modern engineering. The accomplished engineer generally reciprocates the prejudice I have mentioned, for he cannot understand how the worship of the ancients can be really serious; it seems to him three-fourths affectation. This mutual prejudice was fostered by the high wall of separation which at first kept the technical and the liberal branches of study far apart. That wall, I am happy to say, is fast tumbling down, and men are rapidly scrambling over it in both directions. It becomes us, from our various vantage grounds of influence,

to encourage this evolution of a better feeling, a more intimate acquaintance, a mutual respect, and a common zeal for whatever is broad and high and fine.

While we may for many reasons congratulate ourselves on the decided change of front we have achieved in education, we must not be blind to the fact that much remains to be done. We must still devise a scheme of secondary and higher education for a stage of progress in which secondary and higher education may become approximately universal. As Sir Walter Besant put it, the twentieth century must not only "open up all intellectual careers to lads [and lasses] who are capable, clever and ambitious, but we must have a system of education broad enough and elastic enough to include the children who are destined for crafts, industries and arts of all kinds; one that will make them good citizens, not ignorant of their civic rights, and alive to their civic duties."

I do not at all assume that we have yet discovered the true system for universal secondary education. The manual-training high school with its opportunities for training and culture along many lines, industrial, commercial, civic, artistic and literary, seems to come near the ideal, but it is by no means generally accepted, and when accepted it is at once exposed to serious dangers.

In our most advanced communities only a small minority of children enter upon the secondary stage of education. In my own city of St. Louis, only about one boy in seven takes a course in a school of high-school grade. In many communities the proportion in secondary schools is greater—in others it is less. There must be some reason for this; either the training and culture are not what they ought to be or our people are so ignorant that they do not know the value of education. I will not admit that poverty offers a sufficient explanation. In either case, it is evident that we have much to do and much to learn.

Of the dangers to which the manual-training high school is exposed, I have spoken elsewhere at length. I will at present only refer to the strong tendencies of 'practical' people, who are more intimate with the old system of apprenticeship than they are with the art of education, to introduce the teaching of special trades. I think we shall be able to stem this unfortunate tendency, but it is well to be forewarned that we may be forearmed. The advocates of the introduction of trade work make three serious mistakes:

1. They assume that the graduate of the manual-training school is unfitted to enter an industrial shop to advantage.

2. They would begin trade work with pupils who are too young.

3. They do not realize that only about 50 boys in 100 are so constructed mentally and physically that they can and ought to learn what are known as the industrial trades.

In my paper already referred to, I have at some length defended the natural right of a boy to the privilege of choice of occupation at an age of some maturity and after a training which enables him to substitute a rational judgment for a boyish whim.

In this connection, I fail to endorse at least one feature in the Report of the Advisory Committee of the Carnegie Technical School. The full report was published in SCIENCE for July 12, 1901. For a variety of excellent reasons, the Committee reaches the conclusion 'that some new kind of preparation for the work of life must be introduced into the school training of both boys and girls.' It then proceeds to outline a technical college, a technical high school and an artisan day and evening school, which are to meet this demand. Here we have a clear recognition of a twentieth-century problem and an attempt to solve it.

The artisan day and evening school is somewhat on the order of German and English low-grade technical schools. I earnestly hope that the suggestion of this school may be adopted and that the experiment may be fairly tried in America. The plan for a technical college is in complete harmony with our best engineering schools, and needs no discussion here.

The scheme for a technical high school, however, seems to me faulty. This school would be of high-school grade, taking pupils from the grammar schools and covering presumably four years. The normal ages of entrance and graduation would accordingly be 14 and 18.

Three things in the Committee's outline of this technical high school deserve more attention than I can give them at this time :

1. The elective principle is to be recognized, the student selecting the required number of courses under the direction of the director of the school. Here the pupil at a tender age (only 14 or 15) is asked to surrender his birthright to the privilege of choice when he is 18.

2. The course in mathematics—which begins with elementary algebra—is to include the *elements of calculus!* Of course, it must include solid geometry, higher algebra, trigonometry and analytical geometry! One rarely meets with such an astounding proposition from engineers who are supposed to have studied mathematics and to know what they are talking about. They might as well propose that the pupils shall take thermodynamics in a short course of lectures. To be sure, similar ambitious schemes have been proposed elsewhere for boys just out of the grammar school, but they came from people who could have known very little mathematics, and nothing of the uses of the calculus. This criticism may seem trivial, but in more than one place the scheme attempts too much.

3. The technical studies suggested take the form of trade work or special employments, with well-equipped shops and experimental laboratories under the direction of expert artisans.

What Mr. Carnegie will do with this last suggestion remains to be seen, but any attempt to embody it in a real technical high school of secondary grade will be full of interest to the educational world. If any man was well prepared to give the scheme a fair trial that man is Andrew Carnegie; but it will cost a vast amount of money and its experience will teach us how not to do many things.

I have high respect for the members of the Advisory Committee, but I think a less ambitious scheme would be more successful. You cannot teach the higher mathematics in a high school, and I have no great faith in the value of attempts to teach employments, commercial or industrial, within the limits of any secondary school. Such attempts are certain to mislead and ultimately hinder those they aim to help. Any trade or special employment must be dwarfed and narrowed before it can be brought down to the grasp of an untrained boy, and its very narrowness unfits it for the best educational uses.

The school is the place where one should learn the fundamental unchanging laws and manifestations of force and materials. Special occupations, like special constructions, should be analyzed in their elements, and pupils should become expert in such analyses, in so far as they involve universal elements that pupils can comprehend. But there are many things essential to a business employment which cannot even be apprehended in school. As William Mather, M.P., says:

"There is no possibility of teaching in a school that sort of knowledge which practical work carried out on commercial principles, within restrictions as to time of

execution, etc., can alone make any one familiar with." ('Technical Ed'n in Russia,' p. 12.)

As to values, let us teach intrinsic values, not market values; the latter are fluctuating with time and place, the former are permanent.

No scheme of American education is complete without a careful study of the duties and responsibilities of citizenship. The tramp, like the political leech, assumes that the world owes him a living; the good citizen knows that he owes it to the state to earn his own living, to support his family and to contribute his share to the necessary expenses of the city, state and nation. Hence the youth must learn how the city, state and nation are respectively organized and what their proper functions are; and when he is a man he must to the extent of his ability see to it that those functions are placed in the hands of public servants who are both capable and honest. The corrupting influence of a politician who fosters selfishness in his neighborhood, that he and his neighbors may profit at the expense of other neighborhoods, must be counteracted by a generous education which shall cultivate a love of justice and plant the seeds of manly and noble ideals. If democratic governments are to survive, the whole people must be educated to the highest standards of citizenship, and the new education must face and solve the problem of securing those results.

Calvin M. Woodward.
Washington University, St. Louis.

SECTION C (CHEMISTRY) OF THE AMERICAN ASSOCIATION.

In accordance with the recent custom, the meetings of Section C were held conjointly with those of the American Chemical Society, the officers of the latter presiding on Monday and Tuesday and those of the former during the remainder of the session. The meetings proved to be of unusual interest, a large number of valuable papers being presented. Eighty persons, representing twenty-three different States, were in attendance.

The Section was first called to order Monday, August 26, at 11:30 a. m., by Vice-president, Jno. H. Long. Mr. Franklin Guiterman was introduced and welcomed the members on behalf of the chemists and metallurgists of Colorado. Brief responses were made by F. W. Clarke, President of the American Chemical Society and Vice-president Long. Section C was then organized in accordance with the provisions of the constitution. The following were the officers for the Denver meeting:

Vice-president, Jno. H. Long.

Secretary, Wm. McPherson.

Sectional Committee: J. L. Howe, Vice-president, Section C, 1900; A. A. Noyes, Secretary, Section C, 1900; Jno. H. Long, Vice-president, Section C, 1901; Wm. McPherson, Secretary, Section C, 1901; W. D. Bancroft, C. S. Palmer, A. Lachman.

Member of General Committee, H. W. Hillyer.

Member of Council, C. S. Palmer.

Press Secretary, C. L. Parsons.

After the organization of Section C, the officers of the American Chemical Society took charge of the meeting. With the exception of Wednesday afternoon, two sessions were held daily until the final adjournment on Friday. Wednesday afternoon was given up to a visit to the Denver Smelting Works, under the direction of Mr. Franklin Guiterman. A special train conveyed the visitors to the Argo, Grant and Globe Works, successively. In the evening a subscription dinner was given at the University Club by the courtesy of the House Committee. After the final adjournment on Friday a number of the chemists accepted the invitation of Mr. J. D. Hawkins to visit the works of the various smelting companies at Colorado City.

At the meeting of the General Commit-

tee on Thursday evening, Professor H. A. Weber, Ohio State University, and Professor Francis C. Phillips, University of Western Pennsylvania, were elected respectively Vice-president and Secretary of Section C for the Pittsburg meeting, 1902.

The following is a complete list of papers presented at the meeting, together with brief abstracts whenever it was possible to secure these from the authors.

1. 'Report of the Census Committee of the American Chemical Society': CHAS. BASKERVILLE, *Chairman.*

The report included a detailed résumé of improved conditions in the teaching of chemistry in the United States; of the establishment of agricultural colleges, technical institutions, standard bureaus; comparative statements of the training of chemists and chemical engineers in the United States and indications of directions for even greater improvement and extension of the work of the larger institutions; suggestions for the guidance of growth of the smaller colleges.

The complete report will be published in the memorial volume of the twenty-fifth anniversary of the American Chemical Society.

2. 'A Summary of the Analyses of some Massive and Eruptive Rocks of Boulder County, Colorado': CHAS. SKEELE PALMER.

The paper included a condensed statement of the analyses of typical or characteristic rocks of Boulder county. The work was done largely by seniors in the chemical laboratory of the University of Colorado, with the view of training the individual student in the accuracy and independence necessary for original work; also with the further view of adding to the general knowledge of the composition of the rocks of this region. The paper will be published in the *Journal of the American Chemical Society.*

3. 'Recent Developments in Physical Chemistry': WILDER D. BANCROFT.

A résumé was given of the important work done recently in physical chemistry in the various laboratories both in the United States and foreign countries.

4. 'On the Optical Rotation of Certain Tartrates in Glycerol': J. H. LONG.

The rotation of the ordinary tartrates in water is well known, and it has been shown that in dilute solutions the molecular rotations are nearly constant. In this paper the rotations of the following bodies in glycerol are discussed: Potassium sodium tartrate, ammonium tartrate, ammonium hydrogen tartrate, potassium antimonyl tartrate, ammonium antimonyl tartrate and potassium boryl tartrate.

In the cases of the antimony compounds, the molecular rotations agree very well with each other, and also with the rotations in water solution for the same salts; their molecular rotations are therefore very different from those of the simple salts of tartaric acid, which suggests, possibly, that the active acid ion here is no longer that of tartaric acid. Following the suggestion of Clarke, it may be that we have here to deal with salts of tartrantimonious acid $(C_4H_4O_6Sb)OH$, the properties of which are very different from those of the dibasic tartaric acid.

The behavior of the borotartrate in glycerol is very different from that in water, and also different from that of the antimony compound. It is likely that the assumed analogy between these bodies does not hold. There is nothing especially noteworthy in the behavior of the simpler tartrates in glycerol. For Rochelle salt the rotation is larger than that in water and in marked degree variable with the concentration.

5. 'The Atomic Volume Curve in Relation to the Periodic Sequence': CHAS. SKEELE PALMER.

The author proposes a new form of Lothar Meyer's curve which seems to indicate the form in short and long independ-

ent series as the more natural one for the periodic sequence.

The paper will be submitted to the American Chemical Society for publication.

6. 'Report on some of the Mineral Waters of the Philippine Islands': G. B. Frankforter.

The author called attention to the occurrence of lithium in many of the samples. Rubidium and cæsium were also found in some cases.

7. 'Proper Methods of Teaching Physical Chemistry': Wilder D. Bancroft.

According to the author, an introductory lecture course in physical chemistry should begin with the physics of one-component systems, the formation, separation, properties and identification of phases. Next should come the corresponding study of two-component systems, stress being laid on the variation of properties with concentration and the resulting analytical methods. With three-component and four-component systems, chemical methods of analysis become necessary. The general theory of separation by fractional crystallization and distillation comes in at this point. An outline was given of the laboratory course now offered at Cornell University, which is designed to supplement the lecture course and which calls for thirty-three afternoons' work.

8. 'Some Observations on the Teaching of Chemistry': Chas. Skeele Palmer.

The paper emphasized: (1) The value of the thorough study of oxidation and reduction tables as a systematic basis for general inorganic chemistry; (2) the conservative use of the periodic sequence in the form of short and long independent series; (3) the lack of an easy, natural and thoroughly satisfactory introduction to general systematic inorganic chemistry after the consideration of the typical elements and the atomic theory; (4) the use of qualitative reactions in the laboratory work of elementary organic chemistry, pending the use of the necessary but more complicated synthetic work of organic chemistry proper.

9. 'Some Suggestions for the Improvement in Instruction in Technical Chemistry': Arthur Lachman.

This paper will be published in full in Science.

10. 'Discussion of Methods used in Different Universities for giving Instruction to Large Classes in Elementary Laboratory Work': Wm. McPherson.

11. 'Chemistry in the High School': Fredus N. Peters.

12. 'Chemistry in Manual Training Schools': Armand R. Miller.

In this paper the writer gave a description of the method of teaching the subject in the Manual Training High School of Kansas City, Mo. In harmony with the spirit of the school, the practical applications of the subject are prominently brought out and the facts linked, so far as possible, to the things of every-day life. With this same end in view, the pupils are shown through smelters, soap factories, acid works, gas works, etc.

In the study of the metals careful attention is given to the ways in which these occur in nature, the metallurgical processes by which the metals are obtained, and their physical properties, upon which their adaptation to various uses depend. The value of the stereopticon as an aid in arousing and holding an interest in the subject is recognized and a collection of suitable slides is being made. It is not considered wise to attempt to teach qualitative analysis in a one-year course and so all the time is devoted to the study of general chemistry. About one half the time is spent in the laboratory. Brief notes are made there and elaborated at home. A few quantitative experiments are performed in order that the pupils may get some conception of quantitative relations. A course in qualitative analysis is offered, but a second year is de-

voted to it. Pupils who show sufficient ability are encouraged to take up quantitative analysis or assaying, this work being done in the afternoons without credit, as these are not regular courses.

13. 'Notes on the Chlorides of Ruthenium': JAS. LEWIS HOWE.

Claus described double chlorids of trivalent ruthenium of the type $2XCl,Ru'''Cl_3$, and also those of what he considered to be the tetrachlorid of the type $2XCl,RuCl_4$. These last Joly showed to be nitroso-chlorids of the type $2XCl,RuCl_3NO$. Antony has recently succeeded in forming a true tetrachlorid, $2KCl,RuCl_4$, by the solution of potassium ruthenate, K_2RuO_4 in dilute hydrochloric acid.

When ruthenium tetroxid, RuO_4, is treated in the cold with a strong solution of cesium (or rubidium) chlorid and a few drops of hydrochloric acid, it is gradually convertedin to a salt of a new series, cæsium- (or rubidium) oxy-chlor-ruthenate, $2CsCl\text{-}RuO_2Cl_2$, which is instantly decomposed by water. On treatment with strong hydrochloric acid this is converted into the tetrachlorid (chlor-ruthenate), $2CsCl,Ru^{iv}Cl_4$. In most of its reactions it closely resembles the ordinary trichlorid.

This ordinary trichlorid has the formula $2CsCl,Ru'''Cl_3,H_2O$, but numerous other salts exist with varying proportions between the ruthenium trichlorid and the alkaline chlorid.

When the tetrachlorid is warmed in dilute acid solution with alcohol, rose prisms are formed of the same formula as the ordinary trichlorid, but this salt is very distinct in its properties and may be an aqua-trichlorid, $2CsCl,RuOH_2Cl_3$. This gives the tetrachlorid again with strong hydrochloric acid.

The blue solution produced by the action of H_2S on ruthenium solutions can also be obtained by electrolytic reduction, and is, when concentrated, precipitated by cæsium chlorid, but the precipitated salt has not yet been obtained in a state of purity. It seems to have the formula $3CsCl,2Ru''Cl_2,\text{-}2H_2O$, but is receiving further investigation.

After treatment with stannous chlorid, ruthenium trichlorid gives a yellow flocculent precipitate with caustic potash. This is soluble in hydrochloric acid, from which there crystallize brilliant yellow octaedra, containing tin, ruthenium and chlorin. These are being investigated.

This paper will be published in the *Journal of the American Chemical Society*.

14. 'On the Existence of a New Element associated with Thorium': CHAS. BASKERVILLE.

Pure thorium salts obtained from five sources were repurified and fractioned first by sulphur dioxide and second by variation in the solubility of the citrates. Three evidences of the complexity of thorium were offered.

1. Pure thorium dioxide has a specific gravity of 10.2. This was fractioned, giving oxides having specific gravities of 9.25 and 10.53. This corroborates Brauner's work on the hydrolysis of the heptahydrated thorium tetrammonium oxalate.

2. Thorium dioxide is slightly radioactive. Crookes has recently found by fractioning pure thorium nitrate that one fraction was three times as active as the other. The author has found the radioactivity to increase with the increase of specific gravity of the oxides. The oxide having the lower specific gravity is inactive. Description of methods of procedure were given.

3d. Pure thorium tetrachloride was prepared and the atomic weight of thorium determined. $223.25 \pm .05$ was the value found, which is given tentatively. The generally accepted atomic weight is 232.6.

These evidences prove the complexity of thorium and from some data already obtained the new body appears to have an

atomic weight between 260 and 280. As the original material came from the monazite sands of the Carolinas, the author desires, in case the element is ever separated in a pure form, and the indications are most favorable, to have it known as *Carolinium*.

This paper will be published in full in the *Journal* of the American Chemical Society.

15. 'Some New Laboratory Furniture': ARTHUR LACHMAN.

The author described a drawer for storing glass tubing (and showed a photograph). The drawer is open on one end and pivoted at the other. When closed it looks like an ordinary drawer, and does not extend beyond the drawercase. Upon opening, it swings out at an angle, the open end permits the inspection and withdrawal of any piece of tubing.

A special laboratory sink was described. It is 18 inches wide, 30 inches long and 4 inches deep. It is cast of iron, $\frac{3}{8}$ inch thick. The inner surface drains towards the center from all points. The straining plate consists of a perforated plate of lead which is hammered into a flange provided in the sink. The waste pipe is screwed on to a projecting pipe by means of a flange, the projecting pipe being cast into the sink. In this way no screws or other obstructions present themselves in the sink proper and the life of the sink is greatly prolonged. The sinks were cast to order, weigh about 100 pounds and cost about $5.00.

A convenient and cheap air-bath was also described. This is merely an asbestos-covered oven, such as is used for gasoline stoves. Such ovens have been in use in the author's laboratories for over three years with excellent results. They measure about 20 by 14 inches on bottom and are about 20 inches high. A single Bunsen burner can heat them to 170° C. They will hold over sixty funnels for drying purposes. They cost only $2.80 (in Chicago).

16. 'Recent Developments in Organic Chemistry': ARTHUR LACHMAN.

The following is a brief summary of some of the topics considered: The Richter system of registration; direct nitration of paraffins; graphitic acid; Friedel-Crafts reaction; diazo compounds; the uric-acid group; some curious nitrogen compounds and reactions; some artificial substitutes for cocaine; the odorous ingredients of the jasmine and the orange blossom (methyl anthranilate and indol); the odor of the mercaptans; the increasing importance of physical chemistry for the purposes of organic chemistry; catalysis in organic reactions; the two forms of acetylene di-iodide; the chemical nature of alcoholic fermentation; trivalent carbon; the commercial manufacture of artificial indigo. A number of details and calculations are given in this instance. Tautomerism is defined and illustrated in its various forms. The formation of acetoacetic ether. Molecular rearrangements. The stereochemistry of nitrogen, of sulphur, of tin and of iodine—the three first mentioned form optically active compounds. Some new mercury derivatives of organic compounds. Auto-oxidation. Some new organic derivatives of hydrogen peroxide. Quadrivalent oxygen in dimethylpyrone. Is oxygen really acid forming? Thiele's theory of unsaturated compounds and the benzene ring. Nef's methylene theory. Michael's theory of organic reactions. Conclusion: the unity of organic research work.

The complete paper will be printed in the *Journal of the American Chemical Society*.

17. 'The Electrolysis of Certain Proteids': MARY ENGLE PENNINGTON.

A solution of edestin, a globulin from hemp seed, dissolved in 0.6 per cent. orthophosphoric acid and subjected in a partitioned cell to the action of a current of $N.D._{100} = 0.2$–0.4 ampere and 6–18 volts, gives a heavy white precipitate in the cath-

ode chamber. This precipitate, purified as carefully as possible, contains about 2.8 per cent. of phosphorus and 16.41 per cent. of nitrogen. Its properties do not entirely coincide with any known class of proteids, but approach more nearly to those of the nucleo proteids. It is difficultly soluble in pure cold water, easily soluble in hot or boiling water and separates from the hot solution unchanged on cooling. By pepsin-hydrochloric acid digestion it yields a substance containing about 7 per cent. of phosphorus. Decomposition by boiling with sulphuric acid and subsequent treatment for nitrogen bases yields a white, crystalline substance containing nitrogen. The anode chamber, after electrolysis as above, gives a different substance, also containing phosphorus. Egg albumen behaves in an analogous manner. The cathode product showed about 2 per cent. of phosphorus.

This paper will be published in the *Journal of the American Chemical Society.*

18. 'The Reduction in an Alkaline Solution of 2,4,5 Trimethyl Benzalazine and the Preparation of some Derivatives of the Reduction Products': E. P. HARDING.

By reducing 2,4,5 Trimethyl benzalazine,

$$(CH_3)_3C_6H_2CH_2 \cdot NH \cdot N{:}CHC_6H_2(CH_3)_3$$

in an alkaline solution, two reduction products may be obtained depending upon the degree of reduction—one a 2,4,5 trimethyl benzal 2,4,5 trimethyl benzyl hydrazone,

$$(CH_3)_3C_6H_2CH_2{:}\ NH \cdot N{:}CHC_6H_2(CH_3)_3$$

and the other a symmetrical 2,4,5 trimethy dibenzyl hydrazine,

$$(CH_3)_3C_6H_2CH_2 \cdot NH \cdot NH \cdot CH_2C_6H_2(CH_3)_3$$

The hydrazone is a weak base. With picric acid it forms the addition product 2,4,5 trimethyl benzal 2,4,5 trimethyl benzyl hydrazone picrate,

$$(CH_3)_3C_6H_2CH_2NHNCHC_6H_2(CH_3)_3 \cdot C_6H_2(NO_2)_3OH$$

The imid hydrogen atom may be substituted by an acetyl, benzoyl or nitroso group forming the corresponding acetyl, benzoyl or nitroso derivatives, viz:

$$(CH_3)_3C_6H_2CH_2N(COCH_3)N{:}CHC_6H_2(CH_3)_3$$
$$(CH_3)_3C_6H_2CH_2N(COC_6H_5)N{:}CHC_6H_2(CH_3)_3$$

and

$$(CH_3)_3C_6H_2CH_2N(NO)N{:}CHC_6H_2(CH_3)_3$$

By the action of hydrochloric acid it hydrolyzes to 2,4,5 trimethyl benzaldehyde and to 2,4,5 trimethyl-benzyl hydrazine hydrochloride,

$$(CH_3)_3C_6H_2CH_2 \cdot NH \cdot NH_2,HCl$$

from which the free base may be obtained by the action of caustic potash.

2,4,5 trimethyl benzyl hydrazine

$$(CH_3)_3C_6H_2CH_2NHNH_2$$

forms with benzaldehyde, benzal, 2,4,5 trimethyl benzyl hydrazone

$$(CH_3)_3C_6H_2CH_2 \cdot NH \cdot N{:}CHC_6H_5$$

With pyroracemic acid, it forms 2,4,5 trimethyl benzyl hydrazine pyroracemate,

$$(CH_3)_3C_6H_2CH \cdot NH \cdot N{:}C\begin{matrix} CH_3 \\ COOH \end{matrix}$$

It is also capable of forming addition products. With picric acid, it produces 2,4,5 trimethyl benzyl hydrazine picrate,

$$(CH_3)_3C_6H_2CH_2 \cdot NH \cdot NH_2 \cdot C_6H_2(NO_2)_3OH$$

with phenyl mustard oil, it forms 2,4,5 trimethyl benzyl phenyl thio semicarbazide

$$\begin{matrix} (CH_3)_3C_6H_2CH_2NHNH \\ C_6H_5NH \end{matrix} \Big\rangle C{:}S$$

and with cyanic acid, 2,4,5 trimethyl benzyl semicarbazid.

$$\begin{matrix} (CH_3)_3(CH_3)_3C_6H_2CH_2NHNH \\ NH_2 \end{matrix} \Big\rangle C{:}O$$

This paper will be presented in the *Journal of the American Chemical Society.*

19. 'The Identification and Properties of Alpha and Beta Eucaine': CHAS. L. PARSONS.

Alpha and beta eucaine are new alkaloids which quite recently have been offered to the medical profession as a substitute for cocaine. There seem to be certain advantages possessed by beta eucaine which are leading to its quite general acceptance. Chief among these are its comparatively low toxicity, its stability when boiled, which allows the solution to be easily disinfected, and its non-excitation of the heart's action. Both of these alkaloids have been synthesized in the laboratory and so far as known are not a product of life. Beta eucaine acts as a local anæsthetic, like cocaine. Both eucaines resemble cocaine structurally and in general chemical properties they react much like cocaine, being easily shaken out of alkaline solution with ether, petroleum ether, benzine, chloroform, etc. Their chief distinguishing reactions are obtained with ammonia, potassium bichromate, mercurous chloride, platinic chloride, potassium permanganate and their actions under polarized light—both in the polariscope and polarizing microscope. Beta eucaine and its hydrochloride are also characterized by a low solubility in water and alcohol.

This paper will be published in detail in the *Journal of the American Chemical Society.*

20. 'The Alkaloids of Isopyrum and Isopyroine': G. B. FRANKFORTER.

The isopyrum, so far as can be learned at present, has only once been studied chemically. Hartsen in a brief paper on *Isopyrum thalictroides*, reported the isolation of two new alkaloids. The one he named isopyrine and the other pseudoisopyrine. He obtained the isopyrine by extracting the tubers with water and precipitating out the alkaloid by means of ammonia. The alkaloid was obtained in the pure form by extracting this ammonia precipitate with ether. Nothing more was done with the alkaloid. No analyses were made and none of the properties given, not even the melting point.

Pseudoisopyroine was obtained by Hartsen by extracting the root with alcohol after extracting with water. The alcoholic extract was treated with ammonia as in the case of the water extract. On evaporating off the ether the pseudo alkaloid crystallized out in star-shaped crystals. Nothing was done with this substance, not even the melting point was given.

In beginning the work on *Isopyrum biternatum* the method given above was tried, but with unsatisfactory results. In fact, many methods were tried, a few of which gave quantities of the alkaloid. Best results were obtained, however, by first extracting with very dilute hydrochloric acid. The hydrochloride was found to be very soluble in water, and hence readily removed from the solid matter. The alkaloid was finally obtained by extracting the residue from the dilute acid with ether or by first neutralizing with ammonia. This latter step is important unless the acid solution be evaporated cautiously. Moderately strong acid decomposes the alkaloid. By extracting the acid and alkaline residues with alcohol, the hydrochloride and the free base, respectively, were obtained. Both were purified and analyzed, giving results which correspond to the formula,

$$C_{28}H_{46}NO_9$$

In addition to the above, other salts were formed including the platinum double salt and the methyl iodide compound.

$$(C_{28}H_{46}NO_9HCl)_2PtCl_4 \text{ and } C_{28}H_{46}NO_9CH_3I$$

21. 'Derivatives of Camphor Oxime': G. B. FRANKFORTER and P. M. GLASOE.

The great difficulty in the study of camphor oxime is the ease with which it loses a molecule of water and forms the so-called campho nitrile. Camphor oxime acts as both acid and base. We have found that

the basic properties predominate. So marked are its basic properties that it combines with nearly all the common acids and even with the aldehydes forming peculiar para derivatives.

Monochlorcamphor oxime $C_{10}H_{15}ClNOH$.

Until recently no real halogen derivatives of camphor oxime have been made. Free chlorine acts upon it, but forms, instead of a chloride, the common hydrochloride and the nitrile. However, if the oxime is dissolved in ether and treated with sulphur dichloride, the monochloride is formed directly in almost pure state.

Monobromcamphor oxime $C_{10}H_{15}BrNOH$.

The same difficulty in introducing chlorine was experienced in making the bromine compounds. It was finally made by treating a chloroform solution of the oxime in the dark with bromine and allowing to stand until the bromine color had disappeared. The pure substance is inactive toward polarized light, has a specified gravity of 1.48 and an index of refraction of 1.557535 at 15° C.

Dibromcamphor oxime $C_{10}H_{14}Br_2NOH$.

By treating a boiling dilute alcoholic solution of champhor oxime with bromine in excess an oily substance settles to the bottom. The substance was removed, purified and analyzed. The results correspond to the above formula.

Numerous attempts were made to substitute the chlorine and bromine, but as yet results are unsatisfactory. No proof has likewise been obtained of the position in which the halogens enter.

22. 'A Chemical Study of the Seed of *Rhus glabra*': G. B. FRANKFORTER and A. W. MARTIN.

The seed of the *Rhus glabra* or common sumach has been examined, but almost wholly with the idea of determining the amount of tannic acid. In the present paper we have made, so far as possible, an exhaustive examination with special reference to the oils and to the cholesterol present.

We began by studying the seed and husk together, but soon found it advisable to separate them, as most of the oil exists in the seed and all the tannic acid in the husk. The seed contains 9.1 per cent. of oil, while the husk contains 2.5 per cent. On the contrary, the husk contains 7.32 per cent. of tannic acid and 1.35 of malic acid, while the seed contains none.

An examination of the oils showed that the one obtained from the seed resembled that from the husk, the chief difference being in the quantity of foreign substance present. The following is a brief comparison of the properties:

	Seed Oil.	Husk Oil.
Sp. gr. at 15°C.	.923	.933
Index of Refraction at 15°C.	1.48228	1.48764
Saponification Value	194.7	190.1
Iodine Value	86.4	87.2
Drying Properties	None	None
Color	Light yellow	Dark brown

An examination of both the oils showed the presence of a substance resembling cholesterol. It was obtained by the common method for the extraction of cholesterol. It is probable that the substance obtained in each oil is the same. That obtained from the seed oil was so small that it was not studied. The husk oil contained 2.26 per cent. It was readily removed from the oil by acetone. The substance was carefully purified and analyzed. Analysis gave numbers corresponding with the formula

$$C_{30}H_{57}OH.$$

The molecular weight determination gave numbers agreeing with the above formula.

23. 'Phenoxozone Derivatives': H. W. HILLYER.

As indicated in the paper read at the meeting of the Association in New York, when picryl chloride acts on pyrocatechin in presence of two molecules of alkali, one

molecule of hydrochloric acid and one of nitrous acid are split off and a condensation takes place with the formation of dinitro phenoxozone.

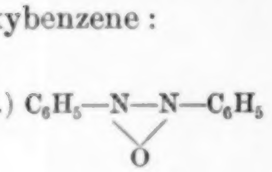
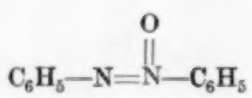
The same kind of action takes place with homopyrocatechin and qualitatively the same action results with the other ortho-dihydroxy compounds; protocatechuic ethyl ester, æsculitin, daphnetin, alizarine and nitropyrocatechin. The condensation products have been isolated but not in quantity to make satisfactory analyses. Most of them yield brilliant carmine solutions when treated with sodium ethylate. The change produced in this way is only superficial since at least in the case of the simplest one, dinitro phenoxozone, the original compound is precipitated on dilution with water.

The substance produced by action of alcoholic soda on dinitro phenoxozone has been further studied and found to be the strong acid dinitro dioxy phenoxide.

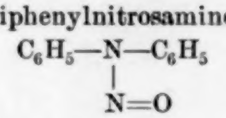
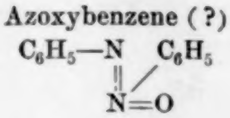
The substance formed by action of one molecule of pyrocatechin, two of picryl chloride and two of alkali is proven to be dipicryl pyrocatechin by analysis and by the fact that it splits off one molecule of picric acid and one of nitrous acid and yields dinitro phenoxozone.

24. 'The Constitution of Azoxybenzene': Arthur Lachman.

Two formulæ have been proposed for azoxybenzene:

(I.)

(II.)


No positive evidence is available for either of these. The author undertakes to show, by a comparison of azoxybenzene with diphenylnitrosamine, that formula (II.) cannot represent the properties of azoxybenzene. There is considerable similarity between (II.) and the structure of diphenylnitrosamine; and since the compounds are isomeric, similarity of reaction may also be expected:

Diphenylnitrosamine

Azoxybenzene (?)


With four different reagents (hydrochloric acid, phenyl-hydrazine, hydroxylamine, and zinc ethyl) the author obtained prompt and decisive reactions with diphenylnitrosamine under circumstances where azoxybenzene was unacted upon. From this it is concluded that only formula (I.) can be regarded as satisfactory for azoxybenzene. This conclusion is strengthened by thermochemical data; the oxidation of azobenzene to azoxybenzene gives off 257 K, whereas all other classes of nitrogen compounds have negative heats of oxidation. This shows that in azoxybenzene the nitrogen and oxygen have attained the maximum saturation of their affinities.

25. 'The Action of Zinc Ethyl on Nitro and Nitroso-Compounds, A Reply to I. Bewad': Arthur Lachman.

Bewad has recently claimed priority for the investigation of the above-named reaction. This priority is unquestioned. But Bewad is mistaken in his explanations of the various results obtained. He assumes that the nitro and nitroso groups, NO_2 and NO respectively, behave in a manner exactly analogous to the carbonyl group, CO. The author shows, on the basis of his own work, that this supposed analogy does not exist; that certain nitroso compounds show a peculiarly unique behavior with zinc ethyl; that other nitroso compounds differ from these first, as well as from carbonyl compounds; and that no reliable conclusions whatever can be drawn as yet from the behavior of nitro compounds. There is also some difference of fact to be noted in the work of Bewad and of the author, which calls for further experimentation.

26. 'Some Hydrochlorated Sulphates':

CHAS. BASKERVILLE, LIONEL WEIL and I. F. HARRIS.

The work of Ditte on $HgSO_4,HCl$ was repeated and found correct. $HgSO_4,2HCl$ was also prepared. Hydrated cadmium sulphate ($3CdSO_4,8H_2O$) was treated with anhydrous hydrochloric acid under different conditions of temperature, time and variation of masses and the water replaced gradually by hydrochloric acid. Eventually, under certain conditions, the sulphuric acid was entirely replaced by hydrochloric acid. E. F. Smith has made similar observations with sodium and potassium sulphates, but in no case was all the sulphuric acid replaced as observed with compounds treated of in this paper.

This paper will be published in the *Journal* of the American Chemical Society.

27. 'The Origin and Use of Natural Gas at Manitou, Colo.': WILLIAM STRIEBY.

The paper opens with a statement of the geological features of the region about Manitou in so far as they have a bearing upon the origin of the carbon dioxid, viz., the limestones at Manitou, the rock-fault following the line of the Ute Pass, the igneous rocks of the higher lands westward at Cripple Creek, etc. Analyses of waters from several springs at Manitou are given and discussed with a view of tracing the source of the mineral matters and gas contained in them. Some theories of the origin of carbon dioxid are briefly summarized and dismissed as inapplicable to this locality. A short discussion of chemical reactions occurring in rocks due to permeating solutions gives a basis for the theory adopted in this paper, and finally a few confirmatory facts are cited and a reference made to the gas springs at Saratoga, New York, and Cañon City, Colorado.

The latter part of the paper details the work done under the direction of the writer in the measurement of the gas given off at some of the springs at Manitou, the calculation of the quantity of carbonated water to be obtained, the design of suitable apparatus for catching the gas and the choice of compression and carbonating machines to produce the gassed mineral water.

The following papers were read by title. With few exceptions, they will be published in the *Journal of the American Chemical Society*.

'Analysis of a Few Southwestern Coals': HERMAN POOLE.

'Copper—Its Scientific and Commercial Value': W. S. EBERMAN.

'The Photometric Analysis of Sulphates': DANIEL D. JACKSON.

'What Constitutes Instruction in Technical Chemistry?' EDWARD HART.

'Review of Recent Work upon the Structure of Metals and Binary Alloys': J. A. MATHEWS.

'Methods of Standardizing Acid Solutions': CYRIL G. HOPKINS.

'The Determination of Sulphur in Iron and Steel': WM. A. NOYES and L. LESLIE HELMER.

'Decomposition of Sodium Nitrate by Sulphuric Acid—Part III': C. W. VOLNEY.

'Quantitative Determination of Hydrofluoric Acid': W. E. BURK.

'A Theory of the Production of Arsine and Stibine in the Marsh and Gutzeit Tests, and Some Causes of Quantitative Variations therein': EDWIN A. HILL.

'A Study of the Chemical Composition of Meat Extracts': H. S. GRINDLEY.

'Chemical Changes produced by the Action of Bacteria': H. S. GRINDLEY.

'Derivatives of Diphenyl Ether': A. N. COOK.

'Some Experiments with the Mononitro-orthophthalic Acids': MARTSON TAYLOR BOGERT and LEOPOLD BOROSCHEK.

'On the Determination of Formaldehyde': A. G. CRAIG.

'A Modification of the Sulphuric Acid Tests for Formaldehyde in Milk': A. GUSTAV LUEBERT.

'The Synthesis of Ketodihydroquinazolins from Anthranilic Acid': AUGUST HENRY GOTTHELF.

'A Comparison of the Solubility of Acetylene and Ethylene': SAMUEL A. TUCKER and HERBERT R. MOODY.

'Cryoscopic Experiments with Sulphur': ALEXANDER SMITH.

'The Electrolytic Determination of Molybdenum': LILY GAVIT KOLLOCK and EDGAR F. SMITH.

'The Indirect Weighing of Quantitative Precipitates': R. W. THATCHER.

'Solid Hydrocarbons of the Series C_nH_{2n+2} and Liquid Hydrocarbons of the Series C_nH_{2n}, in the Less Volatile Portions of Pennsylvania Petroleum': C. F. MABERY.

'Specific Heats and Heats of Volatilization of Hydrocarbons of the Series C_nH_{2n+2}, C_nH_{2n}, and C_nH_{2n-4}, in Pennsylvania, Texas, California and Japanese Petroleums': C. F. MABERY.

'Composition of Commercial Paraffine, Vaseline, and Solid and Pasty Mixtures of Hydrocarbons Collected in Oil Wells': C. F. MABERY.

'Composition and Properties of Asphalts from Different Petroleums': C. F. MABERY.

'The Sulphohalides of Lead': VICTOR LENHER.

'The Theory of Factor Weight in Gravimetric Analysis': C. A. LITTLE.

'On Positive and Negative Halogen Ions': JULIUS STIEGLITZ.

'The Quantitative Separation and Determination of Uranium': EDWARD F. KERN.

'The Discovery of Nitro-Glycerine in an Exhumed Body': G. G. Pond.

WILLIAM MCPHERSON,
Secretary.

MEMBERSHIP OF THE AMERICAN ASSOCIATION.

THE following have completed their membership in the American Association for the Advancement of Science during the month of August:

Frank L. Abbott, Professor of Physical Sciences, State Normal School, Greeley, Colo.

Geo. E. Alexander, Chemist and Mining Engineer, 1736 Champa St., Denver, Colo.

Dr. John E. Almy, Instructor in Physics, University of Nebraska, Lincoln, Nebr.

Miss Theodosia G. Ammons, Professor of Domestic Science, State Agricultural College, Ft. Collins, Colo.

John B. Annear, Chemist, Boulder, Colo.

Geo. F. Archer, 31 Burling Slip, New York, N. Y.

Robert Armstrong, M.D., Boulder, Colo.

Barton O. Aylesworth, President State Agricultural College, Ft. Collins, Colo.

Francis N. Balch, Lawyer, 23 Court St., Boston, Mass.

George Bell, Mineralogist, 200 S. Washington Ave., Denver, Colo.

Edgar H. Berry, Draftsman, 72 E. 87th St., New York, N. Y.

Frank W. Blackmar, Professor of Sociology and Economics, University of Kansas, Lawrence, Kansas.

Fred C. Blake, Boulder, Colo.

Newton A. Bolles, Chemist, 1457 Ogden St., Denver, Colo.

Fred Bond, State Engineer, Cheyenne, Wyoming.

Joseph H. Bowman, Electrical Engineer, Apartado 21, Cordoba, Mexico.

Frank P. Brackett, Professor of Mathematics, Pomona College, Claremont, Cal.

David W. Brunton, Mining Engineer, 865 Grant Ave., Denver, Colo.

Mrs. Emma F. J. Bullene, 1431 Court Place, Denver, Colo.

Virgil M. Came, 315 Quincy Bldg., Denver, Colo.

James Carter, M.D., Carbon, Wyoming.

Rollin T. Chamberlin, Hyde Park Hotel, Chicago, Ill.

Ellery C. Chilcott, Professor Geology and Agronomy, Agricultural College, Brookings, S. D.

Arthur Cobb, Architect, 600 Equitable Bldg., Louisville, Ky.

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Samuel R. Cook, Professor Physics and Chemistry, Washburn College, Topeka, Kansas.

Clifford E. Corwin, Teacher of Science, High School, 508 5th St., Marietta, Ohio.

Mattoon M. Curtis, Professor of Philosophy, Western Reserve University, 43 Adelbert Ave., Cleveland, Ohio.

Alvin S. Daggette, M.D., 400 S. Craig St., Pittsburg, Pa.

A. H. Danielson, Assistant Agriculturist, Agricultural College, Ft. Collins, Colo.

Edward E. Davis, 157 N. 20th St., Philadelphia, Pa.

Manning W. Doherty, Associate Professor of Biology, Ontario Agricultural College, Guelph, Canada.

Charles R. Dryer, Professor of Geography, State Normal School, Terre Haute, Ind.

Philip K. Dumaresq, Sears Building, Boston, Mass.

George M. Duncan, Professor of Philosophy, Yale University, 299 Edwards St., New Haven, Conn.

Miss Alice Eastwood, Curator of Herbarium, Academy of Sciences, San Francisco, Cal.

David C. Eccles, Pharmacist and Chemist, 191 Dean St., Brooklyn, N. Y.

Isaac R. Edmands, Electrical Engineer, Union Carbide Co., 315 Buffalo Ave., Niagara Falls, N. Y.

E. Waite Elder, Instructor in Physics, High School No. 1, Denver, Colo.

Dr. Arthur H. Elftman, Mining Engineer, 706 Globe Building, Minneapolis, Minn.

Wilbur D. Engle, Professor of Chemistry, Univ. of Denver, University Park, Colo.

Philo J. Farnsworth, M.D., Clinton, Iowa.

Professor Wm. C. Ferril, Curator, State Historical and Natural History Soc., 2123 Downing Ave., Denver, Colo.

Dexter M. Ferry, Jr., Seedsman, 1040 Woodward Ave., Detroit, Mich.

Francis A. J. FitzGerald, P. O. Box 118, Niagara Falls, N. Y.

Robert H. Forbes, Professor of Chemistry and Dir. Agr. Exper. Sta., Territorial Univ., Tucson, Arizona.

Floyd C. Furlow, Professor Experimental Engineering, Ga. School of Technology, Atlanta, Ga.

John B. Garvin, Instructor in Chemistry, Denver High School, 2536 W. 34th Ave., Denver, Colo.

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Gustavus E. Gordon, Scientific Director, Walker-Gordon Laboratory Co., 1120 Conn. Ave. N. W., Washington, D. C.

Professor H. A. Gossard, Professor of Entomology, Agric. Coll., Lake City, Fla.

H. P. Grabill, Student of Chemistry, Drake University, 1004 Anas Ave., Des Moines, Iowa.

U. S. Grant, Northwestern University, Evanston, Ill.

Willis H. Grant, Teacher of Chemistry and Geology, Academic High School, Pittsburg, Pa.

Clarence S. Hammatt, Electrical and Mechanical Engineer, Jacksonville, Fla.

Everhart P. Harding, Asst. in Chemistry, Univ. of Minnesota, Minneapolis, Minn.

R. H. Harper, M.D., Practicing Physician, Afton, Indian Territory.

J. Campbell Harris, 119 S. 16th St., Philadelphia, Pa.

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John W. Heston, Pres. S. D. Agri. College, Brookings, S. D.

Charles N. Hewitt, M.D., Secy. State Board of Health, Red Wing, Minn.

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A. M. Holmes, M.D., Jackson Block, Denver, Colo.

Samuel J. Holsinger, Special Agt. Interior Dept., Tucson, Arizona.

Walter D. Hunter, Entomologist, Victoria, Texas.

Elsworth B. Knerr, Midland College, Atchison, Kansas.

Andrew C. Lawson, Prof. of Geology and Mineralogy, Univ. of California, Berkeley, Cal.

Henry C. Lay, Mining Engineer and Geologist, Telluride, Colo.

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J. R. Lovejoy, Electrician, 811 Union St., Schenectady, N. Y.

Otto J. J. Luebkert, Bureau of Forestry, Dept. Agriculture, Washington, D. C.

D. W. McGee, Farley, Iowa.

Howard L. McLaury, Professor of Mathematics and Physics, South Dakota School of Mines, Rapid City, S. D.

John W. Mahin, Teacher in Manual Training High School, 1411 16th Ave., Denver, Colo.

Fredrick Wm. Mally, Entomologist, Orchardist and Nurseryman, College Station, Texas.

Amos L. Mason, M.D., Physician to Boston City Hospital, York Harbor, Maine.

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SCIENTIFIC BOOKS.

A Laboratory Course in Plant Physiology, especially as a basis for ecology. By WILLIAM F. GANONG, Ph.D., Professor of Botany in Smith College. New York, Henry Holt and Company. 1901. Octavo, cloth. Pp. vi + 147.

Practical Text-book of Plant Physiology. By DANIEL TREMBLY MACDOUGAL, Ph.D., Director of the Laboratories of the New York Botanical Garden. With one hundred and fifty illustrations. New York, Longmans, Green and Co. 1901. Octavo, cloth. Pp. xiv + 352.

Professor Ganong's little book is a product of his laboratory, and therefore has the merit of practicality. The illustrations of apparatus (about thirty) are from photographs of the appliances actually used, and the text consists of descriptions of experiments which the author has repeatedly made. The book is in two parts, in the first of which the author discusses methods of study and the necessary equipment, while in the second is given an outline of a course of experiments in the laboratory on protoplasm, nutrition, growth, reproduction and irritability. The author says (p. 23), 'It goes without saying that a greenhouse and a laboratory are indispensable for a course in physiology,' and naturally gives a good deal of attention to the plans and equipment of both. These sections of the book will prove very helpful to those who are building up their facilities for physiological work. The experiments, of which nearly one hundred are specifically indicated, are selected with reference to their availability and practicability in an elementary course. The treatment here is such as to make investigators. The author does not ask numberless leading questions of the 'kindergarten order,' nor does he leave the student without any guide, but wisely follows a middle

path suggested no doubt by his long and successful experience as a teacher.

We would call especial attention to the fact that the author has planned this course 'especially as a basis for ecology.' In some quarters there is a feeling that ecology should be one of the first things brought to the young student's attention, and so we have a swarm of elementary books for secondary school children in which 'ecology' figures prominently. We are in full sympathy with the author when he says, "More than one recent writer has described ecology as at present mostly a series of guesses; and so will much of it continue to be until given logical precision and a firm foundation in exact physiology." Evidently ecology must come *after* the student has prepared himself for it, and *not* as an introduction to botany.

Dr. MacDougal's work is the first American text-book of plant physiology of advanced grade to be published. It is intended for and adapted to the demands of such students as have already made considerable progress in the study of plant activities. In fact, we apprehend that to a large extent it will be the handbook for the teacher, rather than for the student. However used, it must do much to stimulate physiological inquiry in colleges and universities. The aim of the work is thus defined in the preface, "The chief purpose of the author is to present practical directions for the demonstration of the principal phenomena of the physiology of the plant, and also details of experimental methods suitable for the exact analyses requisite in research work."

The sequence of topics is considerably different from that usual in works on the physiology of plants. Thus the author takes up in order, 'The Nature and Relations of an Organism,' 'Relations of Plants to Mechanical Forces,' 'Influence of Chemicals upon Plants,' 'Relations of Plants to Water,' 'Relations of Plants to Gravitation,' 'Relations of Plants to Temperature,' 'Relations of Plants to Electricity,' and other forms of energy, 'Relations of Plants to Light,' 'Composition of the Body,' 'Exchanges and Movements of Fluids,' 'Nutritive Metabolism,' 'Respiration,' 'Fermentation and Digestion,' 'Growth,' 'Reproduction.' It is difficult to specify chapters in a work in which there is so much to commend, but to us the most interesting is that on the 'Composition of the Body' (IX.), in which the treatment, though not extended, is especially satisfactory. Here the principal topics are 'Substances found in Plants,' 'Carbohydrates,' 'Fractional Extractions,' 'Estimation of Tannins and Glucosides,' 'Determination of Sugars and Dextrins,' 'Starch,' 'Cellulose,' 'Proteids,' 'The Fats,' 'Determination of Organic and Inorganic Matter,' 'Enzymes.' We venture to say that the general introduction of the matter of this chapter into plant physiology will revolutionize much of the teaching of this subject in this country. There has been too little of the study of what plants actually are in the physiology of the past, so far as this country is concerned, and it is just here that American botanists have been weakest. This book will serve as a corrective, and it is to be hoped that it will turn the attention of students in physiological laboratories to this much-neglected aspect of their work.

CHARLES E. BESSEY.

NOTES.

THE American Institute of Mining Engineers will, as we learn from the *Railway and Engineering Review*, publish two volumes as follows:

1. 'The Genesis of Ore-Deposits,' comprising the famous treatise of the late Professor Franz Posepny, with the successive discussions thereof by Le Conte, Blake, Winchell, Church, Emmons, Becker, Cazin, Rickard and Raymond (all of which were published in Volumes XXIII. and XXIV. of the *Transactions* of the Institute, and subsequently in the special 'Posepny Volume,' issued by the Institute); also, later, papers by Van Hise, Emmons, Weed, Lindgren, Vogt, Kemp, Blake, Rickard and others, and the discussion of these papers by De Launay, Beck and many others (all of which will be published in Volumes XXX. and XXXI.); also a complete bibliography of the Institute papers and discussions on this subject from 1871 to the present time. The volume now in press will be an octavo of about 825 pages, bound in 'book-linen.' This book will be sent, postpaid,

for $5 to members or others who subscribe for it before its issue.

2. 'The Evolution of Mine-Surveying Instruments.' This will be a volume of about 400 pages, issued in the same style as the foregoing, and containing the original paper of Mr. Dunbar D. Scott on that subject (*Transactions*, XXVIII.), first published in 1898, together with later papers continuing the same subject, and discussions thereof, by Hoskold, Lyman, Davis and many others. Subscriptions will be received for this volume in advance of its issue at $3, under the conditions already stated above.

DISCUSSION AND CORRESPONDENCE.

WEATHER CONTROL.

A CHARACTERISTIC of storms which meteorologists do not perhaps sufficiently consider is that they are the falling down or collapsing of unstable states of the atmosphere. Such phenomena in thermodynamics are called reversible processes ; let us call them *sweeping processes* or simply *sweeps*. The trend of a sweeping process may be affected to any extent, however great, by a cause, however insignificant, provided the cause acts at the critical initial stage of the sweep. For example, a mere breath may determine whether a brick chimney shall fall harmlessly into a vacant lot or with unmeasured calamity into an adjacent factory, or, to take an example from meteorology, an unstable state of the atmosphere over the United States may lead to a cyclonic movement the effects of which may differ enormously according to the time and place that the unstable state begins to break, and in the limiting case the flight of a grasshopper in Colorado or Montana may be the determining factor.

If the cyclonic movements of the atmosphere which have so much to do with the distribution of rainfall are ever to be controlled by the infinitesimal means at the disposal of man it must be by the proper application of these means during the early and exceedingly sensitive stages of these vast sweeping processes. How, when and where to apply our puny power is a matter of detail, of experiment and study.

We must study the initial phases of cyclonic movements in their relations to subsequent trend and character, and we must devise means for inaugurating these initial phases in a way which will lead to desired results. This study has been pursued by the scientists of the Weather Bureau for many years and is the basis of the weather forecasts issued daily by this great scientific department of the government. As to the means for inaugurating at will the storm movements of the atmosphere the smoke-ring cannon of Burgomaster Stiger is the most rational that has yet been suggested, as will be explained later.

Weather control is, however, not so simple a matter as would appear from the above statement. It is a well-known fact that two cyclonic movements initially alike may have very great differences of trend and character. The explanation of this fact will be made clear by considering a simple mechanical analogy. Imagine a great number of dominoes to be stood on end not in a simple row but in a very complicated network of rows and imagine slight disturbances to be produced over the entire system ; for example, a number of grasshoppers might be turned loose into the dominoe enclosure ! Now there might be one particular region where the dominoes are more sensitive than elsewhere so that collapse would usually start in this region and spread over the system, but the ultimate trend and character of the collapse would depend not only upon its initial phases but quite as much upon whether a particularly vigorous grasshopper had happened to kick over a dominoe or two in regions remote from the starting point of the main collapse. The driving energy of the dominoe storm at any given place is derived from the falling of the dominoes at that place and not at all from the remote source of the storm, and if we could imagine the spreading dominoe storm to gradually make the dominoes just ahead of it taller and taller then there would be local displays of excessive violence as these tall dominoes fall. It is scarcely necessary to alter the wording of the above statement, so evident is its application to a vast stretch of atmosphere over a sun-heated continent. The dry arid regions where the sun beats down without hindrance are the regions in which the atmosphere

most quickly reaches a very sensitive state of instability and perhaps the sun-heated air on the rising slope of a mountain may determine the start of the atmospheric overturn. As the atmospheric collapse spreads over the continent its character may be greatly influenced by the degree of instability existing in the regions over which it passes and by the existence of independent storm movements. Furthermore it is known to be the case that a typical cyclone in the United States causes a great mass of warm air to be gathered near the earth's surface on its southeast front and when this mass of warm air and the overlying cold air make a summersault a tornado (cyclone, popularly called) or severe local disturbance is the result.

Our dominoe storm, to carry our analogy further, might be inaugurated with indefinitely small effort at a time when the system is ready for a more or less complete collapse, and the trend of the collapse could be controlled not only by choice of time and place of starting the collapse, but also by starting independent collapses at other times and places, and the control of weather must likewise consist of proper starting of storm movements and of their proper modification by independently inaugurated movements.

Reports are coming to us from southern Europe of the control of hail storms by means of a special form of cannon which throws a large vortex ring at high velocity into the upper atmosphere. In many details these reports are absurd, while in other details they are by no means absurd, although it must be admitted, if we credit the reports, to be a very remarkable fact that this first crude trial to control the weather—for it is the first that conforms at all to the physical requirements of the case—should be in so large a measure successful.

The problem is to upset the increasing instability of the atmosphere on a hot summer's afternoon before the beginning of that particular type of collapse, whatever it may be, that constitutes a hail storm, to set the sky off half-cocked as it were, and it is hard to think of a better means for starting a collapse of an unstable atmosphere than the smoke-ring cannon of Burgomaster Stiger. A simple concussion or loud sound is not at all effective. The thing that is necessary is not a momentary to and fro motion of air such as accompanies a sound wave and which is very slight even in a sound wave of exceedingly great intensity, but an actual transfer of air from one place to another, such as is produced near the muzzle of a gun in what is called the blast, or such as is produced by a vortex ring.

It seems to be within the range of possibility that Stiger's cannon may be a means for controlling all kinds of storm movements.

W. S. FRANKLIN.

REVIEW OF TWO RECENT PAPERS ON BAHAMAN CORALS.

TO THE EDITOR OF SCIENCE: It was my pleasure to visit the American Museum of Natural History in New York during the first week of September, and through the courtesy of Professor Whitfield to examine the recent species of West Indian corals in that institution.

I saw two specimens that have recently been described by Professor Whitfield, and after having received copies of his papers, desire to make some remarks on them.

The first paper is entitled, 'Notice of a Remarkable Case of Combination between Two Different Genera of Living Corals,' *Bull. Amer. Mus. Nat. Hist.*, Vol. XIV., Art. XVII., pp. 221, 222, pls. XXXI., XXXII. (date, July 29, 1901). Professor Whitfield considers his specimen a combination of *Meandrina labyrinthica* and a *Ctenophyllia* which he says is perhaps nearest to *Ctenophyllia quadrata* Dana.

Are two genera represented? Most emphatically no! The *Meandrina* of Milne-Edwards and Haime (not Lamarck, 1801) is characterized by possessing distinctly toothed septa and a spongy columella, in which may be a lamellar element connecting one calicial center with the next; the series are variable in length, often very long, and usually sinuous. The wall between adjoining series is simple (not double as in *Diploria*). The septa and wall are imperforate. Pali may or may not be present; they are not of specific value in this genus. An examination of plate XXXII. will show that there are no generic differences in the specimen figured.

The genus *Ctenophyllia* Dana (= *Meandrina* Lamarck, 1801, + *Pectinia* (pars) Oken, 1815, + *Meandrina* (pars) Lamarck, 1816, + *Ctenophyllia* Milne-Edwards & Haime, 1848, + *Pectinia* Milne-Edwards & Haime, 1851 and 1857) was proposed for four species, *C. pectinata*, *C. quadrata*, *C. pachyphylla* and *C. profunda*. Dana explicitly states that the septa are 'entire or nearly so.' He also says, "This group appears to be related to the Euphylliæ and has been placed in the same subfamily with them." Dana was absolutely correct in his characterization and in his understanding of the systematic relations of the genus. The *Ctenophyllia*, perhaps *quadrata*, of Whitfield differs utterly from Dana's genus *Ctenophyllia*, and according to nearly every modern student of zoophytes it would not be placed in the same family.

It can be seen, by examining the plates, that the valleys and collines of the central portion of the colony are directly continuous with those of the surrounding portion. The differences consist in the absence of pali, and in the larger collines and larger valleys in the central portion. The specimen merely shows the variation which may take place within a single colony.

The second paper is entitled, 'Some Observations on Corals from the Bahamas, with a Description of a New Species,' *Bull. Amer. Mus. Nat. His.*, Vol. XIV., Art. XVIII., pp. 223, 224, pls. XXXIII., XXXIV. (date, July 29, 1901).

The 'new species' described is named *Diploria geographica*. It is merely a form of the very abundant *Diploria labyrinthiformis* (Linn.) emend. Esper (= *Diploria cerebriformis* (Lamarck)). The only difference is in its possessing more angular gyrations than are common in *D. labyrinthiformis*.

These two papers are reviewed because, in my opinion, such errors should be corrected as soon as possible.

T. Wayland Vaughan.
Smithsonian Institution,
Washington, D. C., Sept. 11, 1901.

TWO UNKNOWN WORKS OF RAFINESQUE.

Bibliography does not indicate that Rafinesque ever published a work entitled 'Florula Lexingtoniensis,' or, in fact, it does not seem known that such a work was even contemplated by him. There has been discovered in the herbarium of the Academy of Natural Sciences of Philadelphia a single signature of a work with the above title, consisting of pages 73–80 inclusive, and marked K. As the number of pages would indicate, it is a quarto, though of small size.

Perhaps this intended work met the fate of the 'Western Minerva,' another of Rafinesque's Lexington attempts in literature, which, with the exception of three copies, was suppressed by the printer, because, it is said, the amount of his bill was not forthcoming. It is odd, in any event, that no mention of a 'Florula Lexingtoniensis' was made in Rafinesque's other writings.

Another of Rafinesque's works of which no record seems to have been made is the 'American Florist,' of which at least two parts appeared, as there are two copies of the second part in the library of the above-mentioned institution. This 'Second Series' is also entitled 'Eighteen Figures of Handsome American and Garden Flowers. By C. S. Rafinesque, Philadelphia, 1832.' It is a large sheet, measuring from border to border 21½ by 17½ inches, bearing illustrations of *Arctium latifolium*, *Poteria sanguisorba*, *Betonica officinalis*, *Pyrus malus*, *Bryonia alba*, *Barbarea alliaria*, *Clinopodium vulgare*, *Chrysanthemum leucanthemum*, *Fraxinus quadrangularis*, *Agrostema githago*, *Melissa officinalis*, *Saxifraga granularis*, *Spartium scoparium*, *Buplevrum rotundifolium*, *Primula farinosa*, *Alchemilla alpina*, *Hedera helix*, *Cardamine pratensis*. The illustrations are much like those in his 'Medical Botany,' but are printed in black ink. They bear numbers 19–36, the first series, no doubt, holding numbers 1–18.

William J. Fox.
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RECENT ZOO-PALEONTOLOGY.

The present summer has been rich in paleontological discoveries. The most notable event is the discovery of the body of a frozen mammoth which is now being conveyed to St. Petersburg. Expeditions in this country have been sent out from many of the larger museums, and Professor Von Zittel has sent one of

his assistants, Dr. Broili, with Mr. Charles H. Sternberg, the well-known collector, into the Permian of Texas. The Natural History Museums of London have conducted explorations both in Egypt and in Greece. In the latter country Dr. A. Smith Woodward has been working in the Lower Pliocene of Pikermi, and has secured 47 boxes of valuable fossils, including horses, rhinoceroses and, of still greater rarity, another specimen of the hyracoid, *Pliohyrax*.

Mr. Charles W. Andrews, of the British Museum of Natural History, went on several expeditions into the Nile desert, accompanying the geological survey of Egypt. A year previous he had reported the existence of fossil mammals of undoubted Oligocene age; during the present expedition he made the most important discovery of early and generalized Proboscidea, especially of a small mastodon-like animal, with both premolar and molar teeth in place. Older beds were found to contain a primitive *Dinotherium*. Since the oldest *Dinotherium* and *Mastodon* of Europe are of Miocene age, this discovery not only carries the proboscidean phylum further back, but is strongly in favor of the theory of the African origin of this order. Africa has long been the dark continent of paleontology, and one of the results of English occupation will undoubtedly be a succession of paleontological discoveries of the greatest interest.

The special explorations for fossil horses by the American Museum have been completely successful. The Texas expedition in July secured eight skulls of *Protohippus* with portions of the skeletons associated. They are all in a hard matrix and somewhat crushed. The Colorado expedition has secured a complete skeleton, in a perfect state of preservation, of the large Upper Miocene or Loup Fork horse. This *Anchitherium* is the first complete skeleton of a horse of this period which has been found in this country. The explorations in the same region seem to demonstrate that there were four distinct types of horses, almost contemporaneous. It has been reported also that the Carnegie Museum secured some very complete horse skeletons, but these prove to belong to *Merycochoerus*, an oreodont.

Another discovery of importance, by the Texas party of the American Museum, is the nearly complete shell of the armored edentate *Glyptodon*, four feet in length, together with two feet of the armored tail and parts of the skeleton within the shell. Hitherto *Glyptodon* has only been known from teeth, recorded by Cope from southern Texas, in 1888, and by Leidy from Florida in 1889. The present specimen is almost identical in its elaborate shell-pattern with the Pampean glyptodons.

The explorations for Dinosaurs in the Jurassic have also been very successful. Several discoveries have been reported by the Field Columbian Museum party in western Colorado. A Carnegie Museum party has been working in the sandstone of Marsh's old quarry near Cañon City, and has secured parts of the skeleton of *Morosaurus*, and a skull of *Stegosaurus*. The American Museum has continued its exploration of the Bone Cabin Quarry, in central Wyoming, resulting in the discovery of the skull of one of the large Sauropoda, also the skull of a large carnivorous Dinosaur, and parts of the skulls of two other Dinosaurs, besides a quantity of skeletal material.

The Triassic is still the least known period. Reports from Professor Lester F. Ward of the existence of vertebrate fossils in Arizona led to a party being sent out by the National Museum under the leadership of Professor Ward, assisted by Mr. Brown, of the American Museum, resulting in the discovery of remains both of Dinosaurs and of the primitive crocodile-like Belodons. The Dinosaurs appear to be related to the Stegosaurian division, according to the preliminary examination made by Mr. F. A. Lucas, and there is also a new genus of Belodon in the collection.

H. F. O.

September 9, 1901.

REPORTS OF FOREIGN MUSEUMS.

THE report of the Australian Museum, Sydney, N. S. Wales, for 1899, shows that institution to be doing good work, although hampered by the smallness of its appropriation. Owing to what the curator terms a 'miserable appropriation' for the purchase of specimens, the growth of the collections has been principally

through donations from individuals, 317 donors having presented some 6,000 specimens. This and the attendance speak well for the popularity of the Museum. The government did, however, provide $67,500 for an addition to the Museum building which was already a much finer structure than the National Museum of the United States. The most important accessions were an oar-fish, *Regalecus gesne*, the third of the species known, and an oil-fish, or 'palu,' *Ruvettus pretiosus;* the remainder of the important additions were ethnological. In the exhibition series special attention seems to be given to groups of birds, and fifteen new 'nest groups' were added, besides an additional example of the interesting nest of the bower bird, *Chlamydodera maculata;* this was elaborately decorated at both ends with bones of mammals and birds, shells, pebbles, bits of glass and other objects. It is announced that the manuscript and illustrations for the 'Catalog of the Nests and Eggs of Birds found breeding in Australia' is well advanced. The work will comprise some three hundred pages of text, about one hundred text figures, thirty plates of eggs and forty of nests, and its publication will extend over a period of three years.

The Manchester Museum, Owens College, in its Reports for the year 1900–1901 also makes a good showing for a small expenditure. The principal increase in the collections has been in lepidoptera, plants and mollusks, among the last being an example of the very rare *Pleurotomaria adansoniana.* A specialty of this Museum appears to be the preparation of exhibits of an educational value, and among them is a series of moths selected to represent the families given in the Cambridge Natural History, dissections of Mollusca to illustrate the system of classification based on the gills, and a series of skulls to illustrate dental anatomy and arranged and labeled for the advantage of students.

A series of excellent lectures, addresses and demonstrations was, as usual, given during the year by members of the Museum staff and, as in the past, one is a little surprised at the small attendance on some of these in a city of half a million inhabitants. For example, an address by Boyd Dawkins on 'Our Neolithic Ancestors' drew an audience of only ninety-five. The Sunday lectures, however, were better attended, the most popular being 'The Arrival of Man.' An attractive series is announced for the coming fall and winter.

F. A. L.

SCIENTIFIC NOTES AND NEWS.

The fourth Glasgow meeting of the British Association opened its sessions on September 11. The address of the president, Professor A. W. Rücker, printed in the last issue of Science from a copy sent in advance of its delivery, was given at the inaugural meeting in the evening. Professor Rücker was introduced by the retiring president, Sir William Turner, and the usual vote of thanks was proposed by the Lord Provost of Glasgow and seconded by Lord Kelvin. The general committee held its first meeting on the 11th, when on the proposal of Sir Michael Foster, a cablegram with expressions of sympathy was sent to President McKinley. At the second meeting of the general committee Professor James Dewar was elected president for next year's meeting at Belfast, and the date of the opening of the meeting was set for Wednesday, September 10. It was decided to hold the meeting of 1903 in Southport, where the Association met twenty years previously. Sir W. Roberts-Austen and Dr. D. H. Scott were reappointed as general secretaries, Mr. G. Griffith as assistant general secretary and Professor Carey Foster as general treasurer. The following were appointed vice-presidents for the Belfast meeting: The Marquis of Dufferin, the Marquis of Londonderry, the Earl of Shaftesbury, Sir F. Macnaghten, and the Earl of Rosse, Lord Mayor of Belfast, the president of Queen's College and Professor Ray Lankester.

The University of Adelaide, Australia, will be represented at the Yale bi-centennial by Dr. Edward C. Stirling, professor of surgery.

Mr. F. J. V. Skiff, director of the Field Columbian Museum, has been appointed director of exhibits for the St. Louis Exposition. Mr. Skiff was deputy director-general of the Columbian Exposition, and was director in chief of the United States Commission to the Paris Exposition.

THE gold medal of the Italian Science Society has been presented to Mr. Marconi for his services in the invention of wireless telegraphy.

THE Röntgen Society has awarded a gold medal to Mr. C. H. F. Müller, of Germany, for the most practical X-ray tube for general purposes. There were in all twenty-eight entries.

DR. WILLIAM PATTEN, professor of zoology at Dartmouth College, has leave of absence for the present term and is engaged in zoological work in Russia.

MR. JOHN A. FLEMING, of the U. S. Coast and Geodetic Survey, has arrived in Honolulu for the purpose of erecting and conducting a station for the study of terrestrial magnetism.

DR. CARL LUMHOLTZ, of the American Museum of Natural History, lectured on the Indians of Mexico before the Royal Geographical Society on September 14.

ON the occasion of the seventieth birthday of the great zoologist Leuckart, a portrait-bust was made by the sculptor, Seffner. He has undertaken to supply Professor Charles L. Edwards, of Trinity College, with a plaster cast. If others wish to secure copies of the bust, Professor Edwards is willing to forward the orders. The cost in Leipzig would be from 40 to 50 Marks.

THE death is announced of Dr. Philip S. Baker, who for many years held the chair of chemisty in the medical department of De Pauw University.

THE death is announced at the age of seventy-three years of Dr. Ferdinand Arnold, a German botanist, known for his researches on lichens.

DR. J. L. W. THUDICHUM died in London on September 7. He was born in Germany and graduated from the University of Giessen about fifty years ago, but soon came to London and engaged in medical practice. He conducted researches on physiological chemistry and was also the author of a volume on the 'Chemistry of Wine Production.'

THE Tufts College laboratory of biology, at South Harpswell, Maine, was closed for the year on September 6. During the summer every table was occupied. Among those who availed themselves of its facilities for varying lengths of time were Professor Alvin Davison, of Lafayette College, Dr. Emily Ray Gregory, of Wells College, Professor Albert F. Matthews, of the University of Chicago, Professor M. A. Wilcox, of Wellesley College, Dr. C. B. Wilson, of the Westfield Normal School and Dr. F. A. Woods, of Harvard University. During the winter the laboratory will be enlarged, providing a number of private rooms for investigators.

AN International Office of Weights and Measures is to be established in Sèvres for the preservation of standards and the supplying of copies.

AN annex to the Astronomical Observatory, at Cambridge, England, is being constructed on the north side of the dome to be used as a laboratory.

THE daily papers report that Mr. S. J. Holsinger, a special agent of the Department of the Interior, has presented a report stating that pottery and other remains have been taken in an unauthorized manner from the ruins in Arizona and New Mexico, and that the government may claim the collections deposited in several museums.

THE Vallauri Prize, of the value of about \$6,000, will be awarded in 1903 for the most important scientific work accomplished whether by a foreigner or an Italian during the preceding four years.

WE learn from the London *Times* that, following their acceptance of the proposal of the British Association for an ethnographic survey of India, Lord Curzon's Government has adopted the suggestion of the Royal Society for the carrying out of a magnetic survey. Sun spots are believed to be closely connected with the perturbations of the magnetic needle, and, as Sir Norman Lockyer's inquiries are held by him to establish some association between sun spots and Indian droughts, the survey, besides subserving the cause of science, may prove to be of some practical utility from the administrative standpoint. The existing magnetic observatories at Bombay and Calcutta being

inadequate as base stations for the vast area the survey will cover, similar observatories are in course of construction at Dehra Dun, below the Himalayas, at Kodaikanal, in the Madras Presidency, and at Rangoon. The Dehra Dun observatory will be under the supervision of Colonel Gore, R.E., the Surveyor General of the Indian Survey (whose headquarters are located there); but the other four will be in charge of Mr. John Eliot, the meteorological reporter to the Government. The Survey and Meteorological Departments will, in fact, be jointly responsible for the investigations. The field observations will be carried out by six or seven detachments of the Survey Department, and these will be controlled by Captain Fraser, R.E., who has recently been arranging in England for the purchase of the necessary instruments. Sind and the Punjab will first be taken in hand; and, as the country is now intersected with railways in all directions, enabling field detachments to quickly cover the distances from one observing station to another, it is anticipated that five years will suffice to complete the field work of the preliminary magnetic survey.

THE representatives of the newly-established Australasian confederation have appointed a commission to consider the adoption of the metric system, and it is reported that with the approval of the authorities in Great Britain, the system will be adopted in Australasia.

A NEW steamship for the U. S. Coast and Geodetic Survey, being constructed by the Townsend and Bowney Shipbuilding Company, was launched in Newark Bay on September 21. The steamship, which has been called *The Bache* in honor of the former eminent superintendent of the Coast Survey, is 136 feet in length, with a steel frame, and is to be fitted with engines developing 125 horse power.

A COMMITTEE of the Chemical Section of the British Association has been appointed to urge upon the Government the desirability of remitting the duty on alcohol used for chemical research.

IT is officially estimated that the deaths from the plague in India during the past five years exceed 600,000. Unfortunately there is no abatement. For the last week for which details are at hand there were 2,816 deaths as compared with 2,003 in the preceding week, and only 285 in the corresponding week of last year. The Bombay districts are at present suffering the most severely.

THE correspondent of the *Lancet* in India reports that bacteriological work is being started at several new places. The Port Commissioners at Rangoon propose building and equipping a laboratory chiefly at first for the examination of suspected plague. The Government of the Malay States has recently established a Research Institute open to all workers irrespective of nationality. Pathological work and chemical research, as well as bacteriological investigations, will be open to all.

THE corporation of the City of Hull has made itself responsible for the conduct of the museum of the Literary and Historical Society.

THE executive committee of the National Educational Association will meet early in October to determine the place of meeting of the next convention.

THE International Congress of Physiology opened its sessions at Turin on September 17.

AN International Congress of Archeologists will be held in Greece in April, 1903. Meetings will be held at Athens, Olympia, Delphi and other points of interest.

THE International Engineering Congress, the general program of which we have already published, opened in Glasgow on September 3, with about 3,000 members in attendance.

THE eighty-first meeting of the American Institute of Mining Engineers will be held in Mexico in the first week of November. Sessions will be held in the cities of Mexico, Pachuca and Monterey, and stops will be made at various points of interest. Two special trains have been chartered, one of which will leave New York on November 1, by the Pennsylvania Railroad, and the other will be run as a second section, starting from Chicago at 10 p. m., on November 2, by the Atchison, Topeka & Santa

Fe Railway. The cost of the trip from Chicago, lasting about thirty days, including berth and meals will be $250.

THE Dutch Society of Sciences at Harlem announces a series of subjects for the prizes to be conferred during the next three years, the details of which can be obtained from the Secretary, Professor J. Bosscha, Harlem. The prize in each case is a gold medal or 500 florins at the option of the author and the papers may be written in English.

THE *British Medical Journal* gave in a recent issue the prizes offered by the Paris Academy of Medicine, about thirty of which are open to foreigners. The François-Joseph Audiffred Prize is of the value of £1,000, and is offered to any person who is adjudged to have discovered a preventive or cure of tuberculosis. The following are also among the more important offered for the year ending with the end of February, 1902; the sum specified in each case does not necessarily go to one candidate, but may be divided. The Academy Prize, awarded annually, worth about £40, is this year for a research on the *rôle* of toxins in pathology; the Baillarger Prize of about £80 (biennial) is for the best work on the treatment of mental diseases and the organization of asylums; and the Charles Boullard Prize, also biennial, of £50, is for a similar subject. The Barbier Prize of £80 (biennial), is for the discovery of a cure for such 'incurable' maladies as hydrophobia, cancer, epilepsy, typhoid and cholera. The Mathieu Bourceret Prize of £50 (annual) is for work on the circulation of the blood. The Campbell Dupierris Prize (biennial), of the value of £96, is for the best work on anæsthesia or the diseases of the urinary passages. The Chevillon Prize (annual) of £65, is for the best work on the treatment of cancer. The Desportes Prize of £55 (annual), will be awarded for the best work on practical medical therapeutics. The Herpin (of Metz) Prize (quadrennial) of £50, is offered for a research on the abortive treatment of tetanus. The Theodore Herpin (of Geneva) Prize of £125 (annual), is for a research on epilepsy and nervous diseases. The Laborie Prize of £210 (annual), is given for the greatest advancement in surgical science during the year. The Lefèvre prize (triennial) of £75, is for a research on melancholia. The Meynot Prize (annual), of £108 is for the best work on ear disease; and the Saintour Prize (biennial) of £166, for the best work on any subject in medicine.

WE learn from the *Astronomical Journal* that the council of the *Astronomische Gesellschaft* has undertaken the preparation of a new Catalogue of Variable Stars and has delegated the conduct of the work to a committee consisting of Professors Dunér, Hartwig, Müller and Oudemans. The committee request observers of variable stars who have considerable unprinted series of observations, which would be useful in the correction of elements, either to publish them soon or to communicate them to the member of the committee in charge, Professor G. Müller, Potsdam Observatory. The Committee also announces that it will from the present time undertake the definitive notation of newly discovered variables as soon as their light-fluctuations are certainly ascertained. A list will shortly be published of the names of variables found in recent years which have heretofore remained unnamed.

THE New York *Sun*, whose astronomical news is unusually full and accurate, notes that the foreign associates of the Royal Astronomical Society are distributed as follows: Argentine Republic, 1; Austria, 1; France, 9; Germany, 8; Holland, 3; Italy, 2; Russia, 4; Sweden, 1; United States, 14. It is to be noted that the associate from the Argentine is himself an American. The American members are: Dr. E. E. Barnard, Yerkes Observatory, Chicago; Professor L. Boss, Dudley Observatory, Albany; Professor S. W. Burnham, Yerkes Observatory, Chicago; Dr. S. C. Chandler, Cambridge; Dr. W. L. Elkin, Yale University; Professor G. E. Hale, Yerkes Observatory, Chicago; Professor A. Hall, U. S. N., retired; Dr. E. S. Holden, New York; Dr. S. P. Langley, Smithsonian Institution; Professor A. A. Michelson, University of Chicago; Professor S. Newcomb, Washington; Professor E. C. Pickering, Harvard College Observatory; Professor C. A. Young, Princeton University, and Dr. J. M. Thome, National Observatory, Argentine.

UNIVERSITY AND EDUCATIONAL NOTES.

The construction of a new science building, costing $300,000, has been begun at Colorado College. Towards this building Dr. D. K. Pearsons gave $50,000 and an anonymous donor has recently given $100,000.

The equipment of the Whitin Observatory of Wellesley College has received the addition of a sidereal clock, built by the E. Howard Clock Company of Boston.

Mr. James S. Dickson, of Glasgow, has given £10,000 to the University of that city for the endowment of a lectureship of mining.

Lord Kelvin delivered the inaugural address on the occasion of the formal opening of the James Watt Laboratory of Engineering at Glasgow University on September 3. The cost of the laboratory has been about $200,000, toward which sum about $125,000 has been subscribed.

We learn from the London *Times* that the new technical school with museum extension in William Brown street and Byrom street, Liverpool, the foundation-stone of which was laid on July 1, 1898, by Sir William Forwood, chairman of the Library, Museum and Arts Committee of the Liverpool Corporation, is now practically completed, and its doors will in a few days be opened to students in general. The new building, designed by Mr. E. W. Mountford, is of the modern nineteenth-century classic style, and built of Stancliffe stone, from the same quarry whence was obtained the material for St. George's Hall. It extends from the Brown Public Museum to Byrom street, where there is an imposing curved front, and the seven windows of the lower art gallery are separated by couples of Ionic columns, over thirty feet in height. The technical school occupies three lower floors of the building as well as some galleries at the very top, and is entered from Byrom street, while the two upper floors form an extension of the Brown Museum, and are entered only from that building. Notable features of the William Brown street frontage are two bold, projecting bays, with deep vaulted arches enriched with simple decoration, while emblematic statuary fills in the pediment, all the statuary being from the studio of Mr. T. W. Pomeroy. In the basement, which is very little below the street level, are many rooms and laboratories intended for various handicrafts, with up-to-date apparatus. In a cross-gallery on the top floor of the building is a chemical laboratory where about threescore students can work, while above all is an observatory with a large equatorial telescope. Altogether the school has accommodation for 1,300 students at one time, and the electric lighting and 'Plenum' ventilation are excellent in all departments. In the chemical and nautical rooms students are already at work.

Dr. E. E. Schieb, of the University of South Carolina, has been appointed professor of philosophy and pedagogy in Tulane University.

Dr. T. H. Haines, has been appointed assistant professor of philosophy in Ohio State University.

Dr. L. W. Ladd, who is a son of Dr. George T. Ladd, professor of philosophy at Yale University, has been appointed to the newly established Hanna chair in the Medical College of Western Reserve University.

Dr. Emily Ray Gregory has been appointed professor of biology, Wells College, Aurora, N.Y.

At Dartmouth College Mr. George H. Lyman, of Beloit College, has been called as successor to Dr. George T. Moore, professor of botany, who has accepted a government position at Washington. Charles E. Bolser, A.B. (Dartmouth), Ph.D. (Göttingen), has been appointed instructor in chemistry.

Professor Joseph French Johnson has resigned the chair of finance in the University of Pennsylvania and accepted the chair of political economy and banking in the New York University school of commerce, accounts and finance.

Dr. A. Stansfield, instructor in assaying under Sir W. C. Roberts-Austen, at the Royal College of Science, London, has been appointed to the newly-established chair of metallurgy in McGill University.

Dr. Kasner has qualified as docent in meteorology in the Polytechnic Institute at Berlin; Dr. Weinhold for mathematics at Kiel; Dr. G. Rost for mathematics at Würzburg, and Dr. E. Haunig for botany at Strasburg.